MACHINERY

SEPTEMBER 13, 1961 ONE SHILLING & THREEPENCE

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CINCINNATI

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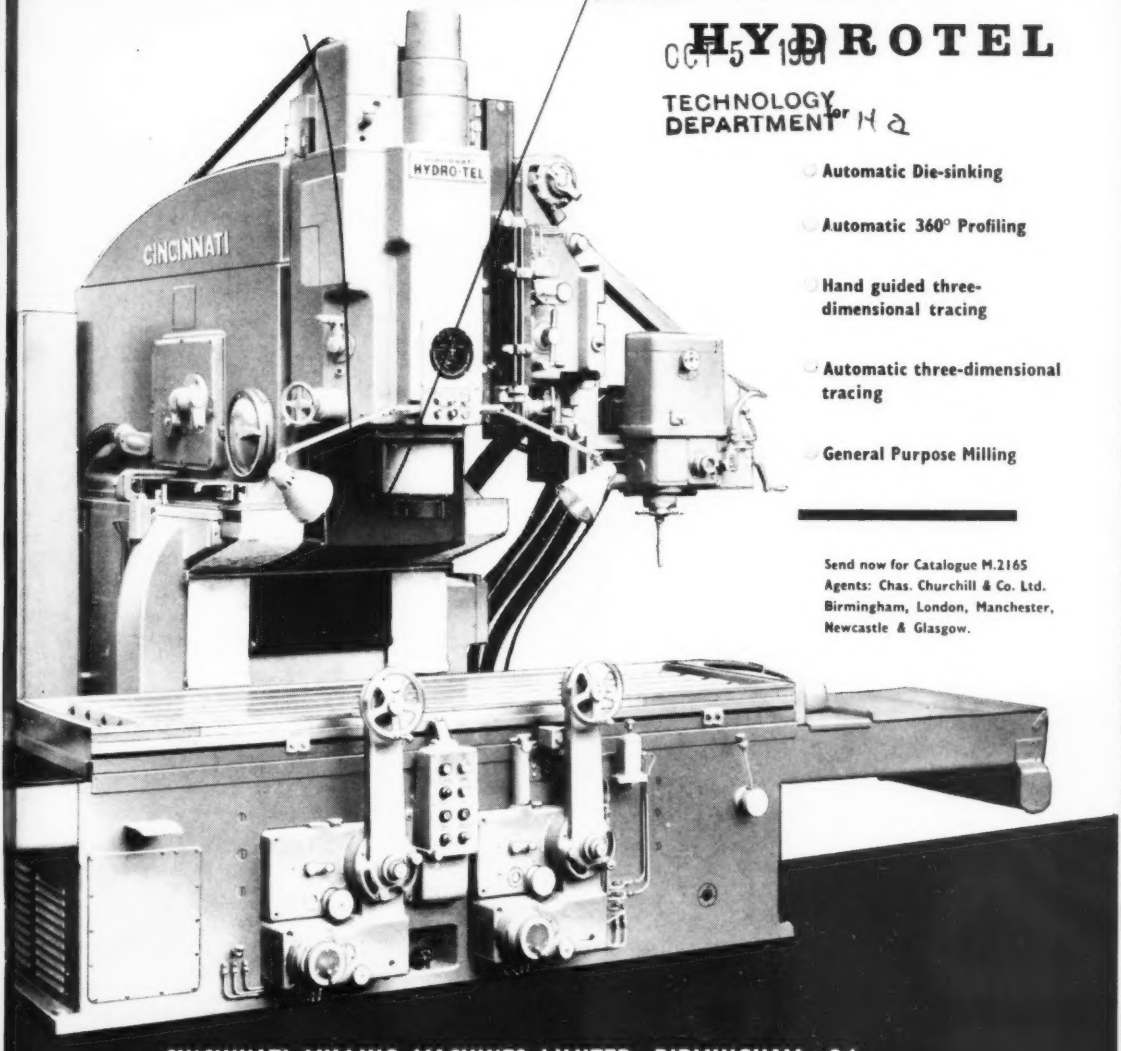

- Automatic Die-sinking
- Automatic 360° Profiling
- Hand guided three-dimensional tracing
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- General Purpose Milling

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Agents: Chas. Churchill & Co. Ltd. Birmingham, London, Manchester, Newcastle & Glasgow.

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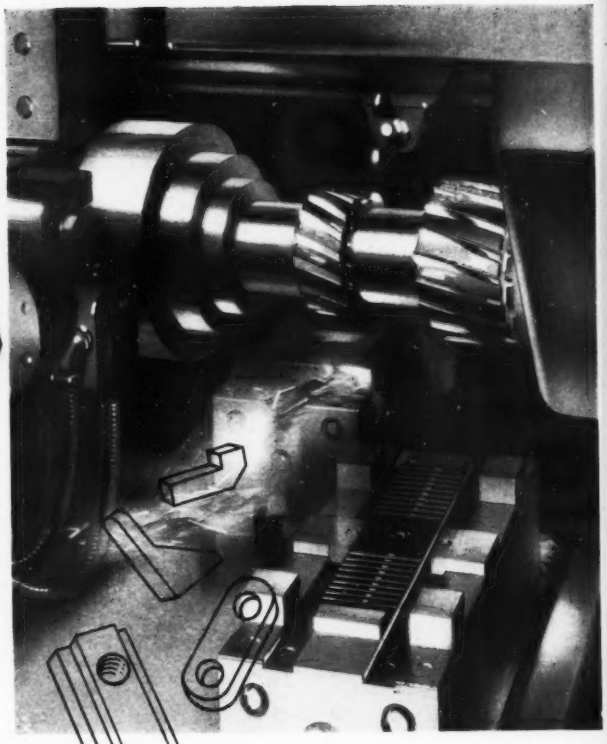

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MILLS KEYS are used in all branches of the engineering industry.
The high quality of their workmanship and the low prices have created such a heavy demand that standard types in carbon steels are now always in stock. Special materials, finishes, machining features or heat treatment can be supplied at short notice and there is a large capacity for "specials" to customers own drawings.

Our technical services are available to advise you on the physical properties, design and any other problem connected with Keys or similar components.

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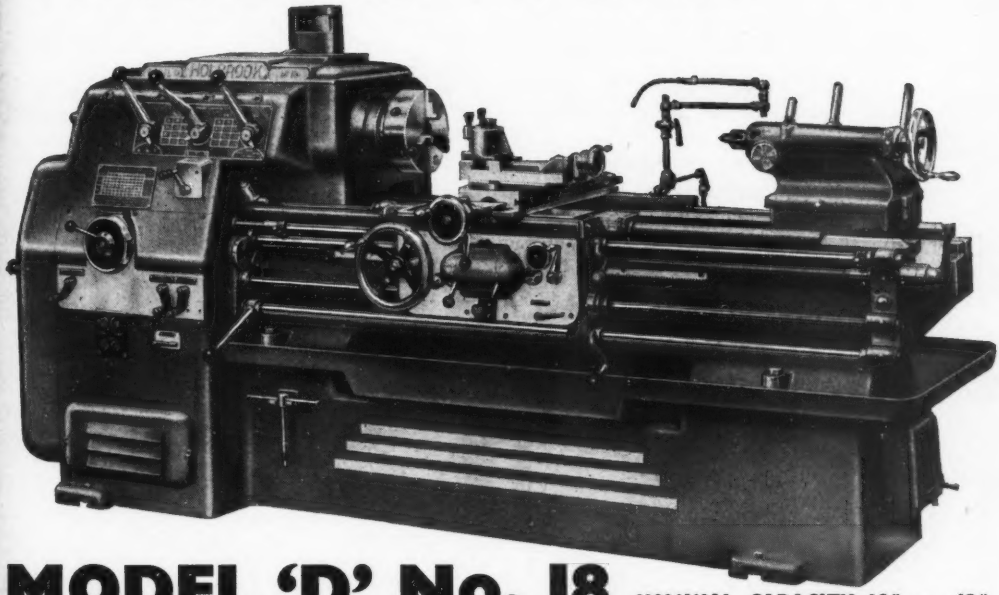
PRODUCTION WITH PRECISION

. . . . . 18 SPINDLE SPEEDS 15 TO 1000 R.P.M.



MODEL 'D' No. 18 NOMINAL CAPACITY 18" × 42"

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HARDENED BEDWAYS

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PRECISION LEADSCREW WITH COMPENSATING END THRUST

PRECISION GROUND COVERED BEDWAYS
60 THREADS & FEEDS : ELECTRIC SUDS PUMP
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Telephone : HARLOW 2351-2-3

HOLBROOK MACHINE TOOL CO. LTD.

CAMBRIDGE ROAD, HARLOW, ESSEX

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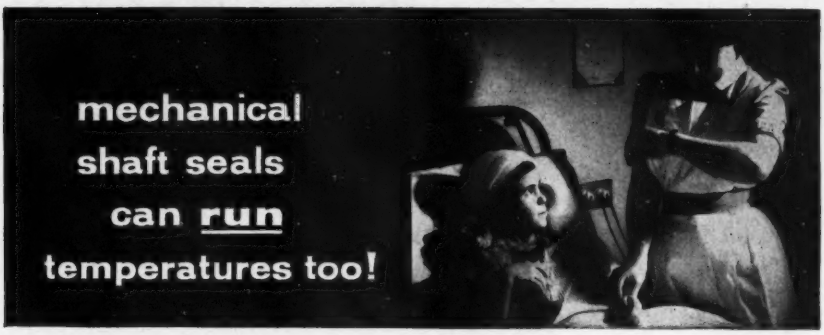

. . . but with a single invention we have struck at, and eliminated, the root cause of many mechanical shaft seal failures . . . *localised high temperature conditions at the seal face.*

CRANE Extended Surface Seats dissipate heat as rapidly as it is generated. Seal face temperatures *stay within* 10°C. *of the temperature at which a liquid is being handled* . . . 40°C. to 50°C. lower than is practicable when a stationary seat of conventional design is used.

The designs—there are two, ESY Type and ESW Type—*have been developed and patented* by Crane Packing Ltd., and they are exclusive to CRANE Mechanical Shaft Seals.

For a detailed explanation of the causes of localised high temperature conditions at the seal face, and for a full description, with dimensional data, of CRANE *Extended Surface Seats* **interested Engineers should write to CRANE PACKING LIMITED, of Slough, Bucks,** *a Company.*

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BV 28 — — 29in.
BV 32 — — 32in. SWING OVER BED
BV 36 — — 37in.

24 speed headstock
4.9 - 400 or 7.5 - 600 r.p.m.
Helical final drive to spindle
48 change feed screwcutting gearbox

Optional extras include

- ***12 belt spindle speeds of 100 - 800 r.p.m.***
- ***Power feed to 360 deg. swivelling tool-slide***
- ***Quick power traverse of carriage and cross-slide***

CENTRE LATHES FROM 17in. (430 mm) TO 42in. (1065 mm) SWING
SURFACING AND BORING LATHES OF 17in. (430mm) AND 25in. (635 mm) SWING
LATHES FOR SPECIAL PURPOSES/MATERIALS

DENHAM'S ENGINEERING CO. LTD., HALIFAX, ENG.
Member of The Charles Churchill Group of Companies

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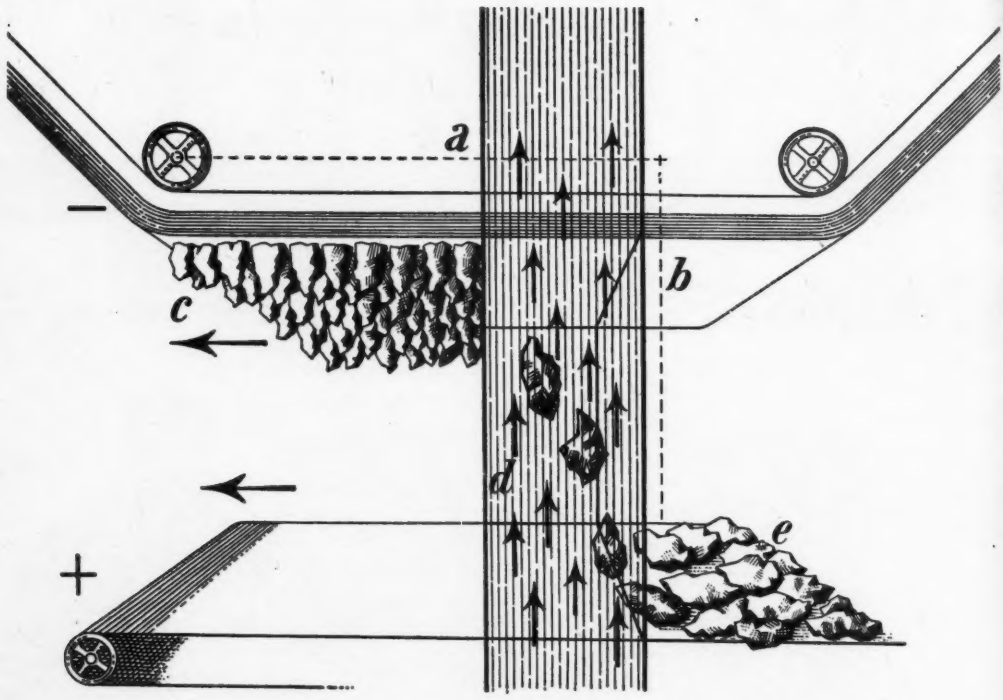

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YES a million cuts! And here's why

Every razor-edged grain in EAC abrasives stands bolt upright, presenting maximum cutting power to the work in hand. The grit, orientated on its longitudinal axis, is shot arrow-like into the adhesive by electrostatic force. That's why EAC abrasives literally bristle with cutting edges, work faster and last longer than ordinary makes. There's the right EAC abrasive for every operation. Insist on EAC for the best of good reasons—it saves money!

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coated abrasives

ENGLISH ABRASIVES CORPORATION LIMITED

Marsh Lane, Tottenham, London, N.17. Telephone: Tottenham 5057

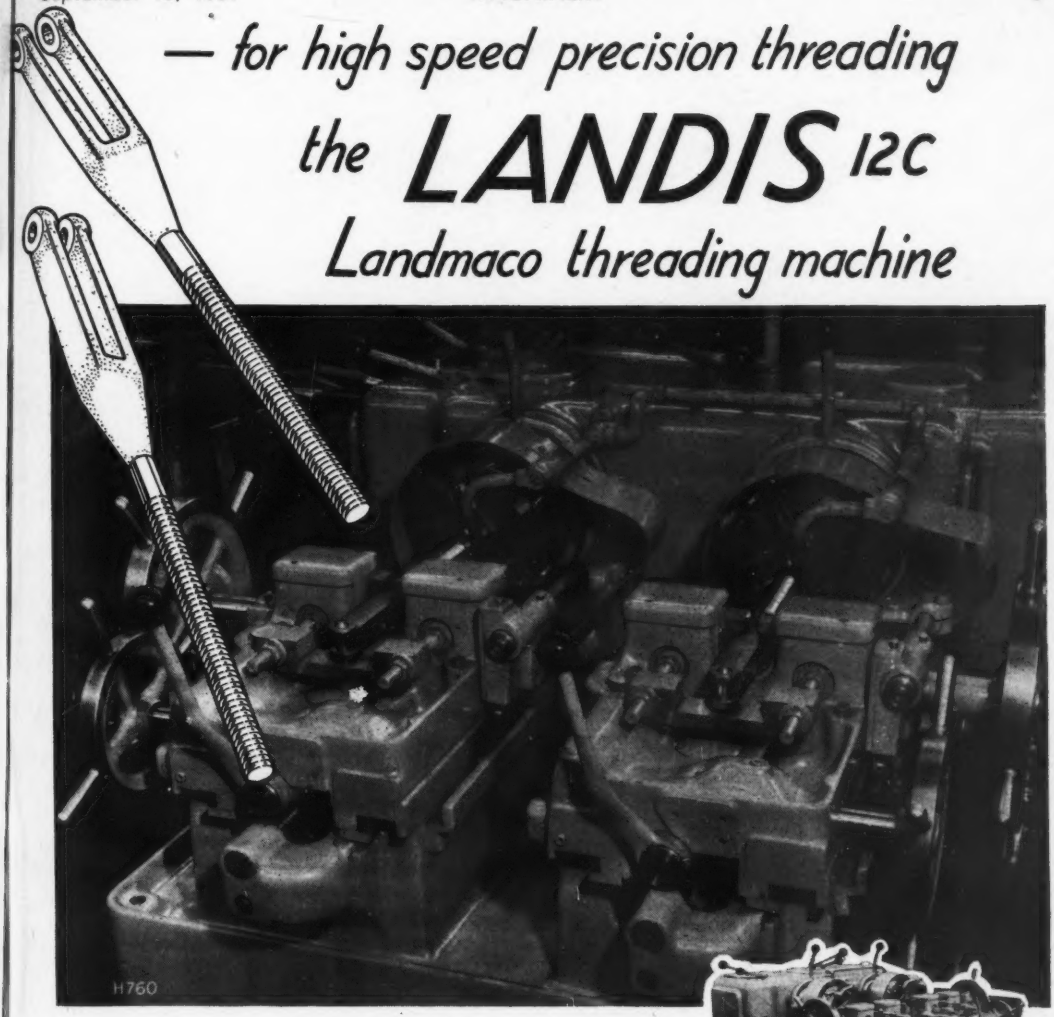
Subsidiaries Thos. Goldsworthy & Sons Ltd. The Helvetia Abrasives Co. Ltd. London Abrasives Ltd.

811/6

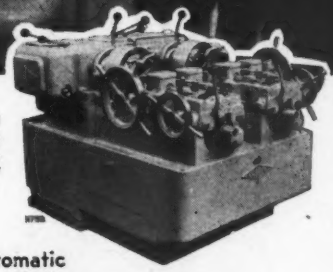
— for high speed precision threading

the LANDIS 12C

Landmaco threading machine



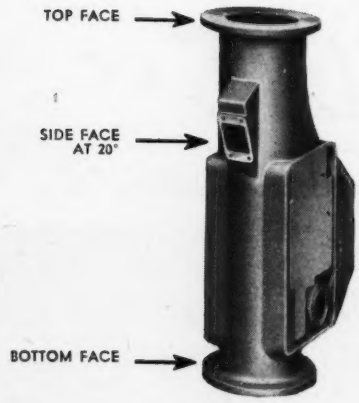
At the Imperial Foundry of the Ford Motor Co., Ltd., Leamington, 35-ton tensile steel hydraulic lifting rods are threaded (1⅞" dia. × 9 pitch U.N.C. × 8" long) at the rate of 135 rods per hour. Spindle speed of 113 r.p.m. Leadscrew-controlled carriages ensure accurate thread reproduction; pitch error is only ·0003" over a 6" length.



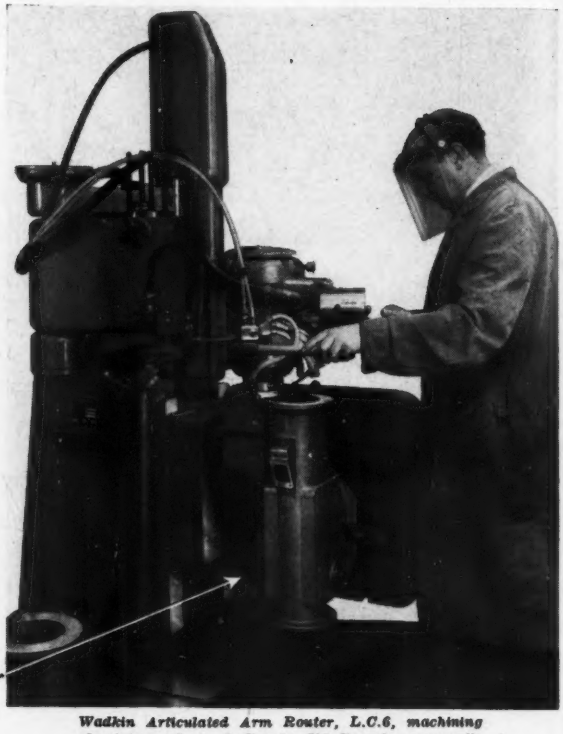
Landis machines are available in a range of types and sizes:— Automatic Forming and Threading Machines — two sizes ¾" and 1". Four-spindle Semi-automatic Threading Machine — two sizes ¾" and 1". Lan-nu-rol and Lanhyrol Thread Rolling and Forming Machines 6C, 12C and 20C Landmaco Threading Machines with capacities of ¼" - ¾" bolt or ⅛" - ¾" pipe, ⅜" - 1½" bolt or 1⅛" - 1½" pipe and ½" - 2½" bolt or ¼" - 2" pipe respectively, single or double-spindle models. A complete range of Pipe Threading and Bolt Threading Machines also available.

ALFRED HERBERT LTD., COVENTRY Factored Division, Red Lane Works.

AD 612

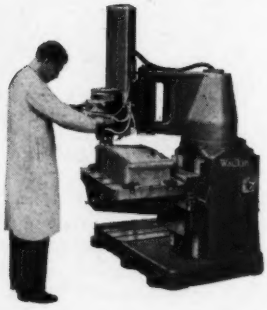


The floor-to-floor time for milling the three faces is 6 MINUTES!



Wadkin Articulated Arm Router, L.C.6, machining aluminium selector bodies for 5½" diameter pneumatic tube system. Photographs by courtesy of the Lamson Engineering Co. Ltd., London, N.W.10.

The fastest means of milling light alloys



Wadkin type L.C.6, with table canted 10° to the right to present an inclined top face.

The Lamson Engineering Co. Ltd. appreciate the time-saving cost-cutting advantages of a machine specially designed for the rapid, precision milling of light alloys. That's why they have recently installed a Wadkin Articulated Arm Router, type L.C.6. This is a relatively inexpensive, medium capacity machine with cutting speeds up to 18,000 r.p.m., power rise and fall to the head, integral base plate, and a unique rising and falling canting table. Full details of the type L.C.6, and the heavy duty machine, type L.C., are given in Leaflet 945 available on request.

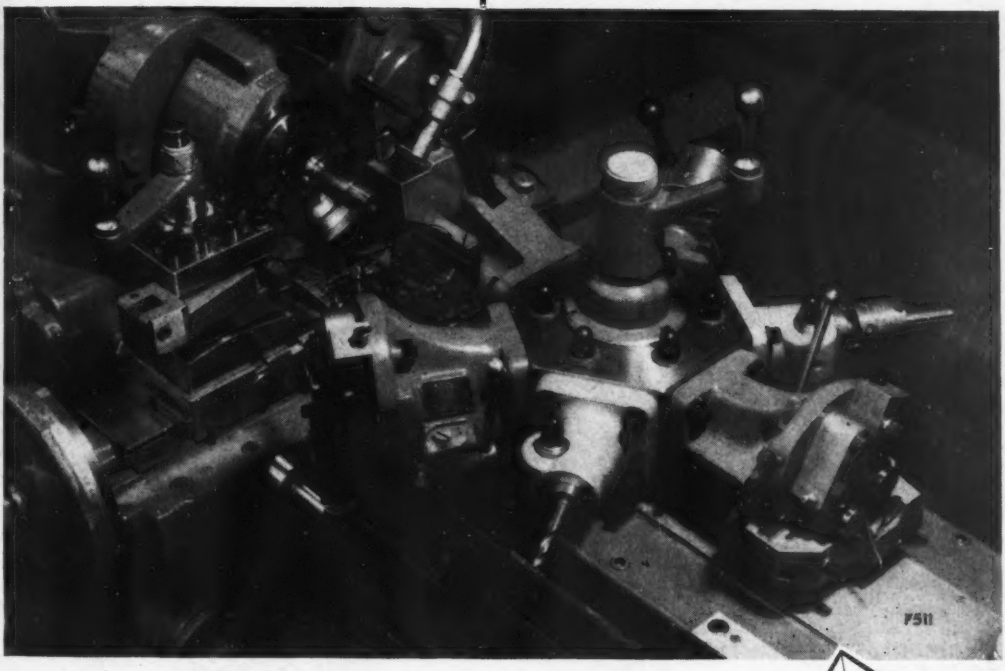
Wadkin

HIGH SPEED MACHINE TOOLS

Wadkin Ltd., Green Lane Works, Leicester. Tel: 68151. London Office: 62-64 Brook St., W.1. Tel: MAYfair 7048

Ardoloy
An A.E.I. Product

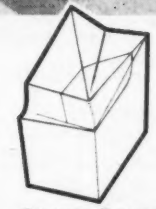
Chipstream Tools for high cutting speeds with minimum tool wear



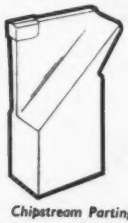
Tooling set-up on a Herbert No. 2D Capstan Lathe with Programme-control system for machining a mild-steel gear stud in a total time of 2 minutes 10 seconds. Included in the tooling are two Chipstream Boxtools and a Chipstream Parting-off Tool. These tools ensure rapid metal removal, fine finish and exceptional long tool life.

The Ardoloy-tipped Chipstream turning tool can be used in the Chipstream Boxtool, Turner or Rear Toolpost is presented tangentially to the workpiece ensuring maximum rigidity. The vee groove in the top cutting face of the tool assists in the natural curling of the turnings and directs them away from the work.

The Ardoloy-tipped Chipstream Parting-off Tool is essentially a high-production tool for operating at a high cutting speed and medium to fine feed. The chevron-shaped top face imparts added strength and assists chip flow.



Chipstream Turning Tool



Chipstream Parting-off Too

ALFRED HERBERT LTD., COVENTRY

AD432

for rapid super accurate setting —

The

BUSWELL & SWEENEY

MASTER BAR

JIG BORER

A medium sized jig borer which combines accuracy with ease of operation and speed of setting

BRIEF SPECIFICATION:

Table size: 25in. by 42in.
Travel 30in. by 18in.
Settings to 0.0002in.
Steplessly variable spindle speeds up to 1,800 r.p.m.
Feeds (4) from 0.001in. to 0.008 in.
Power setting traverse 60in. per min.

Full details from the Patentees and Makers

BUSWELL & SWEENEY LTD. BOLTON ST., BIRMINGHAM, 9

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EVEN QUICKER and BETTER

IMPROVED MODELS IN THE MARBAIX RANGE OF DISINTEGRATORS

MODEL M.61-CS
Completely self-contained with Servo feed, requiring NO ATTENTION FROM OPERATOR whilst cutting is in progress.

MODEL M.61-C
Self-contained model with universal head fixture and adjustable cross-arm.

MODEL M.61
Similar to Model M.61-C but without head fixture and cross-arm.

MODEL M.60
Bench Model, primarily intended for the removal of broken tools.

Any of the above models will:—

* **REMOVE BROKEN TOOLS FROM COMPONENTS RAPIDLY. CLEANLY AND WITHOUT DAMAGING COMPONENT.**
* Cut holes at any angle and of any shape in hardened materials.

MARBAIX INDUSTRIES LTD. VALIANT HOUSE, VICARAGE CRESCENT LONDON, S.W.11 Telephone: BATTERSEA 9593

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THE Hare 7½ TON HYDRAULIC PRESS

WITH AUTOMATIC INDEXING TABLE

applied to High Speed Assembly

. . . at A. C. DELCO LTD.

This automatic assembly operation utilises to good effect the perfect integration of five HARE features—all of them vital in the attainment of maximum output, precision, economy and safety. These features, interlocked in a closely controlled hydraulic cycle are:-

RAM LOADING

Pressure can be accurately preset so as to ensure consistent loading for every stroke.

RAM SPEED

A high approach speed is slowed automatically to pressing speed. Return speed is adjusted to provide loading interval.

RAM STROKE CONTROL

Provision is also made for limiting the movement of the ram to any distance short of the full 8 inches.

TABLE INDEXING

The hydraulic circuit is arranged so that each step in the cycle is complete before the next is initiated.

COMPONENT EJECTION

Ejection is automatic and hydraulically operated.

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SPECIFICATION	
Stroke	8"
Ram Speed (Advance)	300" or 600"/min.
Ram Speed (Pressing)	25" or 50"/min.
Ram Speed (Power Return)	50" or 100"/min.
Ram Speed (Spring Return)	600"/min.
Hole in Table	3" or 5"
Table Surface	12" x 10" or 18" x 12"
H.P. of Motor	2

Write for full details to—

P. J. HARE LTD. WRINGTON, Nr. BRISTOL, SOMERSET. Tel. Wrington 262

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ON

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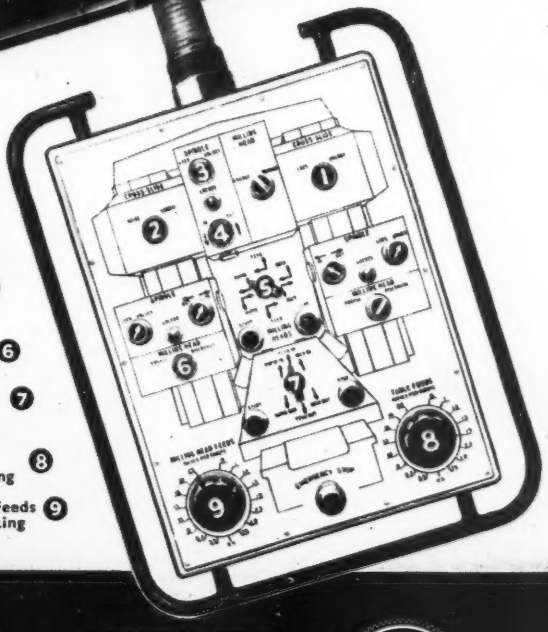
Fingertip Control for Easy Operation & Maximum Output

16 Spindle Speeds
16 Table Feeds
16 Milling Head Feeds
Automatic Spindle Setting for Multiple Speeds
Optical Measuring Equipment

Pendant Controls



1. Cross-slide : Lock or Unlock
2. Cross-slide : Raise or Lower
3. Spindle : Lock or Unlock
4. Spindle Traverse : Down or Up
5. Milling Heads Traverse : Select Direction and whether Rapid Feed or Inch
6. Milling Head : Unclamp & Start or Stop & Clamp
7. Selector for Table Traverse : Select direction and whether Rapid, Feed or Inch
8. Selector for Table Feed : Adjustable even during cutting
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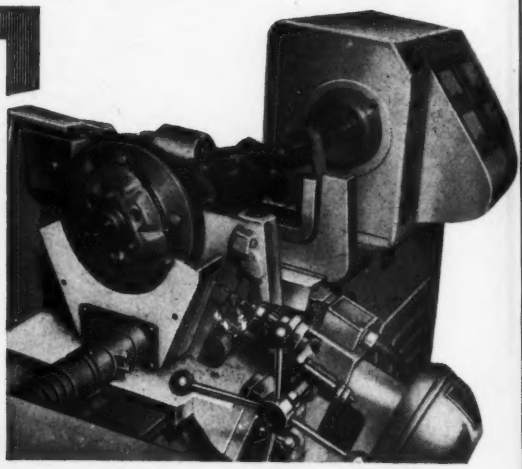
ASSOC. BRITISH MACHINE TOOL MAKERS LTD ABMTM

K.256

Balancing Crankshafts for the new AUSTIN Seven



JACKSON - BRADWELL

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The natural choice for precise results

In common with most other automobile builders, the Austin Motor Co. Limited use JACKSON-BRADWELL dynamic balancing machines to ensure precise results at the lowest possible cost.

In the illustration above we show our Model O/3E engaged on crankshaft assemblies for the new Austin 7. This machine gives immediate and precise readings of the amount and location of unbalance and is equipped with a built-in drill head for the removal of surplus material.

The JACKSON-BRADWELL range of balancing machines is all embracing and we will gladly send you details of a model suitable for your own work.

JACKSON & BRADWELL LIMITED., Grove House, Sutton New Road, Birmingham 23

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BALANCING FOR THE TRADE

We can offer Balancing capacity on Jackson-Bradwell Balancing equipment for weights from 5 lb. to 600 lb. and lengths up to 5 ft. All work is carried out promptly by experts at reasonable prices. Send us your enquiries.

BALANCING & TECHNICAL SERVICES

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Fine turning lathe with fully automatic loading and unloading.

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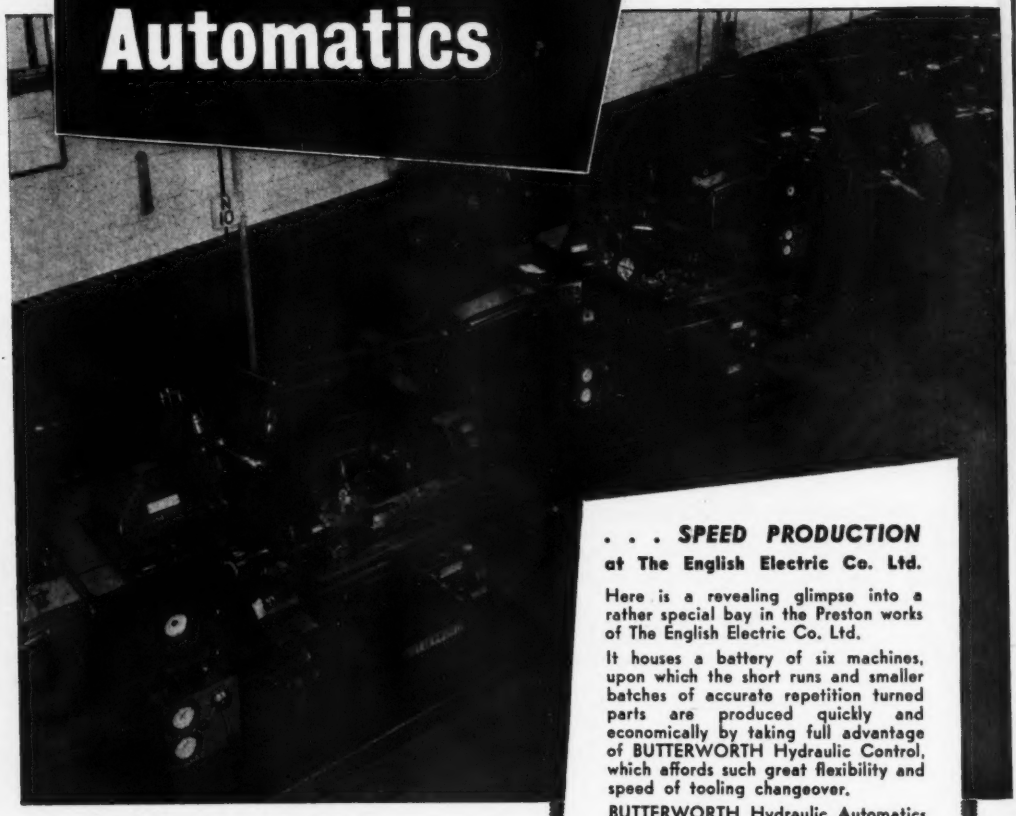
NRP 3553

Butterworth British Automatics



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at The English Electric Co. Ltd.

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It houses a battery of six machines, upon which the short runs and smaller batches of accurate repetition turned parts are produced quickly and economically by taking full advantage of BUTTERWORTH Hydraulic Control, which affords such great flexibility and speed of tooling changeover.

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BUTTERWORTH Hydraulic Controlled Automatics are supplied in the following Spindle Capacities, $1\frac{5}{8}$", 2", $2\frac{1}{2}$" and 3" Light Duty, and 3" and $3\frac{1}{2}$" Full Duty and for Light Chucking Work.

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BUTTERWORTH BRITISH AUTOMATIC MACHINE TOOL CO., LTD.

LINCOLN STREET : ROCHDALE

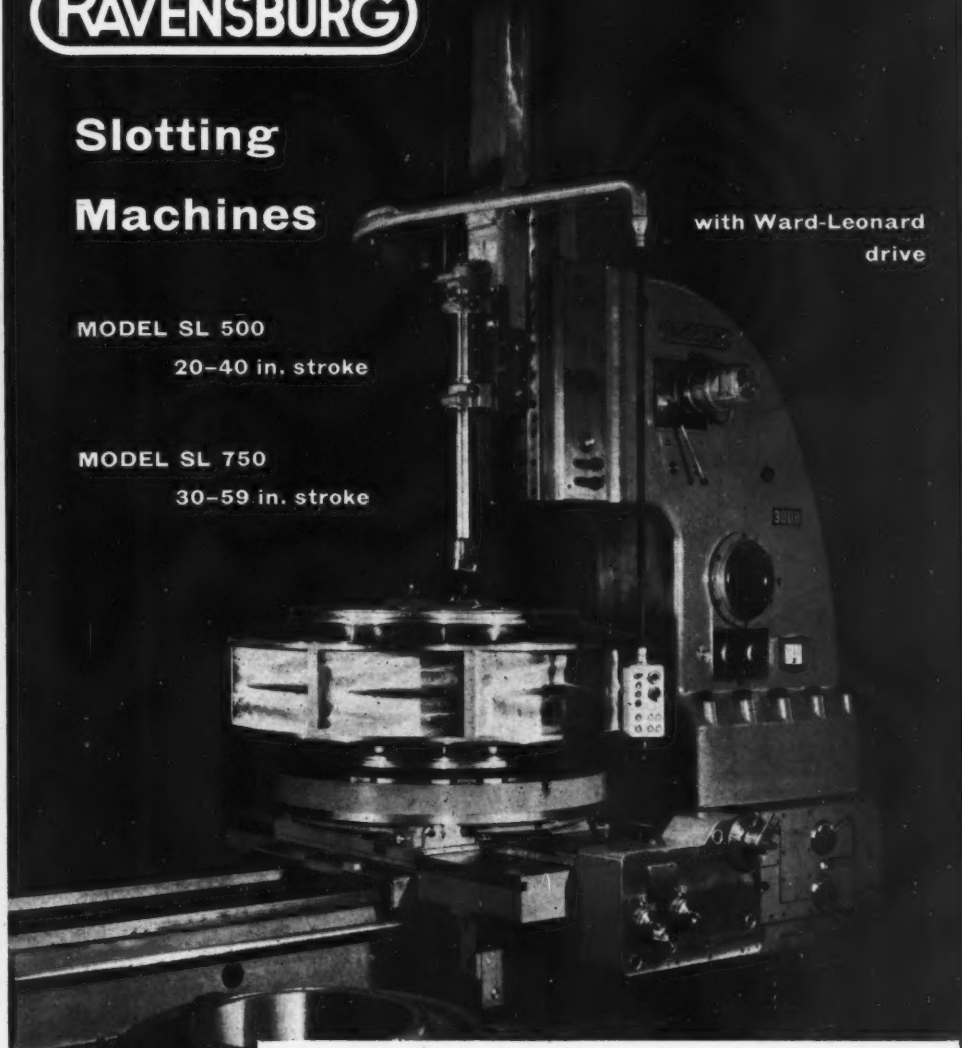
RAVENSBURG

Slotting Machines

with Ward-Leonard drive

MODEL SL 500
20–40 in. stroke

MODEL SL 750
30–59 in. stroke



★ Infinitely variable ram speeds.
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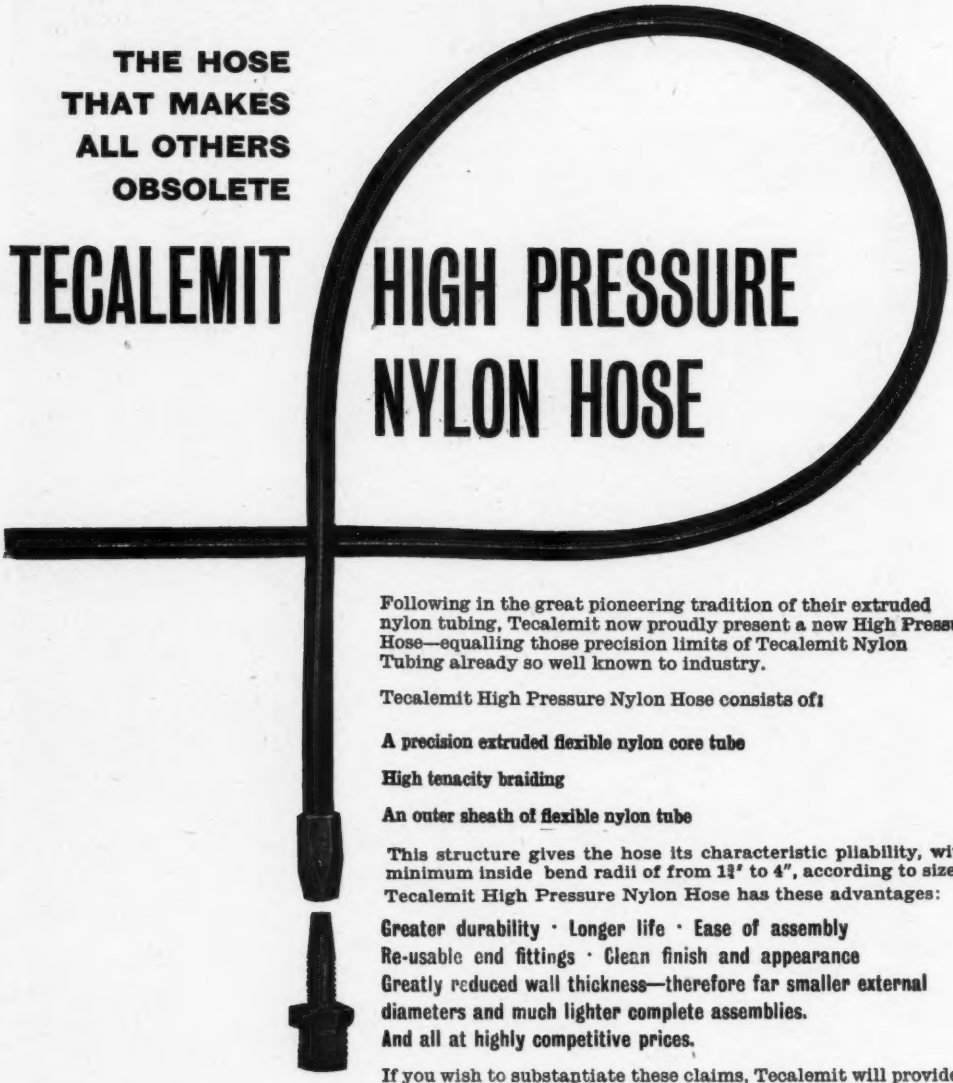
THE HOSE THAT MAKES ALL OTHERS OBSOLETE

TECALEMIT HIGH PRESSURE NYLON HOSE



Following in the great pioneering tradition of their extruded nylon tubing, Tecalemit now proudly present a new High Pressure Hose—equalling those precision limits of Tecalemit Nylon Tubing already so well known to industry.

Tecalemit High Pressure Nylon Hose consists of:

A precision extruded flexible nylon core tube

High tenacity braiding

An outer sheath of flexible nylon tube

This structure gives the hose its characteristic pliability, with minimum inside bend radii of from 1¾" to 4", according to size. Tecalemit High Pressure Nylon Hose has these advantages:

Greater durability · Longer life · Ease of assembly
Re-usable end fittings · Clean finish and appearance
Greatly reduced wall thickness—therefore far smaller external diameters and much lighter complete assemblies.
And all at highly competitive prices.

If you wish to substantiate these claims, Tecalemit will provide sample standard lengths of hose assembled with common forms of coupling, so that test rigs can be undertaken.
Tecalemit High Pressure Hose is supplied in five sizes ¼", ⅜", ½", ¾" and 1" internal diameter, to meet the needs of industry for hydraulic and pneumatic systems.
Write for full technical details of Tecalemit High Pressure Nylon Hoses and their use on hydraulic and pneumatic systems for:—
Agricultural Machinery · Earth-moving Plant
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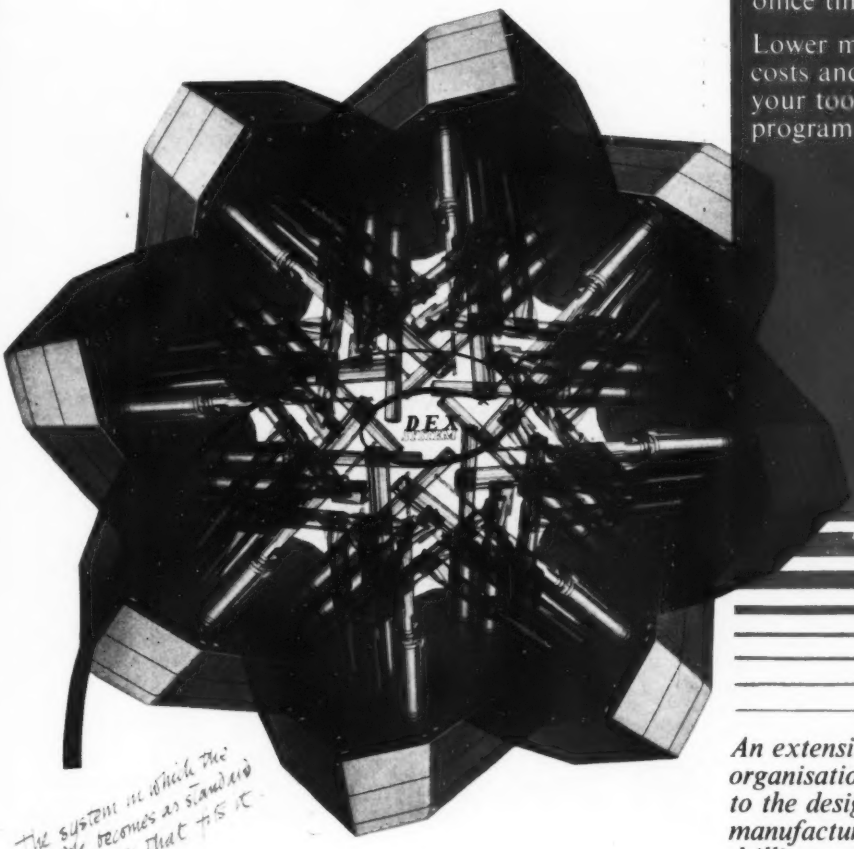
TECALEMIT (ENGINEERING) LIMITED (SALES MY) PLYMOUTH DEVON
T700

Multi Drilling



The system in which the spindle becomes as standard as the drill that fits it

DEX SYSTEM multi drilling gives Multi-Head standardization

Off the shelf service for standard parts

Savings in drawing office time

Lower manufacturing costs and speeds up your tooling programmes.

An extensive organisation devoted to the design and manufacture of multi drilling equipment.

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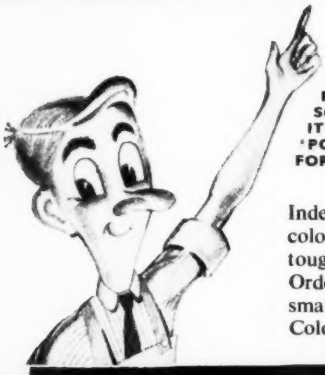

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Indestructible operator is made entirely of metal. High-density polyethylene colour caps are permanently coloured, won't fade or deteriorate on even the toughest jobs. Pushbuttons are completely oil-tight even when depressed. Order pushbutton in the colour you want or get the basic operator and with a small stock of colour caps, decide your colour at the point of application. Colour caps just " Pop-on "—may be changed in seconds if necessary—design leadership AT NO EXTRA COST. Seven colours available. Choose from black, red, green, brown, yellow, orange, blue.

A *Complete* LINE OF OIL-TIGHT CONTROL UNITS

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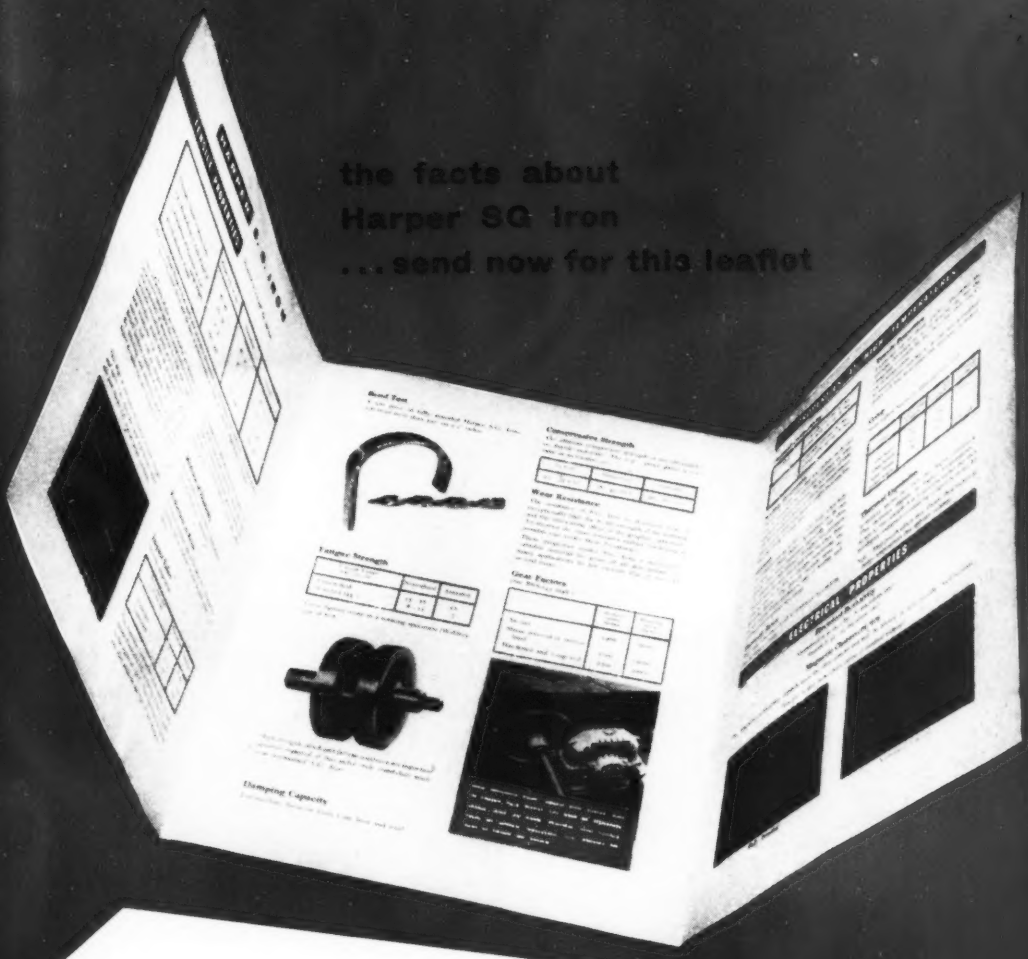
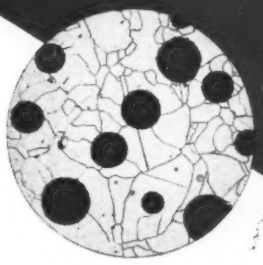


Harper SG iron can be cast closely and accurately to shape, yet by exploiting its higher strength, rigidity and resistance to shock you can achieve results superior to those from alternative materials. This leaflet contains full metallurgical, engineering and design specifications for Harper SG iron, and is invaluable to all draughtsmen and engineers. In addition to the mechanical properties (which meet all grades of B.S.S.2789: 1961) this leaflet lists electrical and magnetic data, and gives heat treatment and general information.



This photomicrograph illustrates the structure of Harper annealed SG iron, the properties of which are described in the leaflet.

Harpers will be pleased to send you a booklet which describes their castings in SG iron, grey iron and Harper-Meehanite (the word 'Meehanite' is a registered trade mark). On Lloyd's List for SG iron and Meehanite castings. Metal pressings, machining, enamelling and sub-assembly work are all part of the Harper service.

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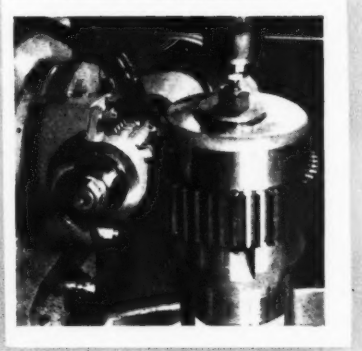

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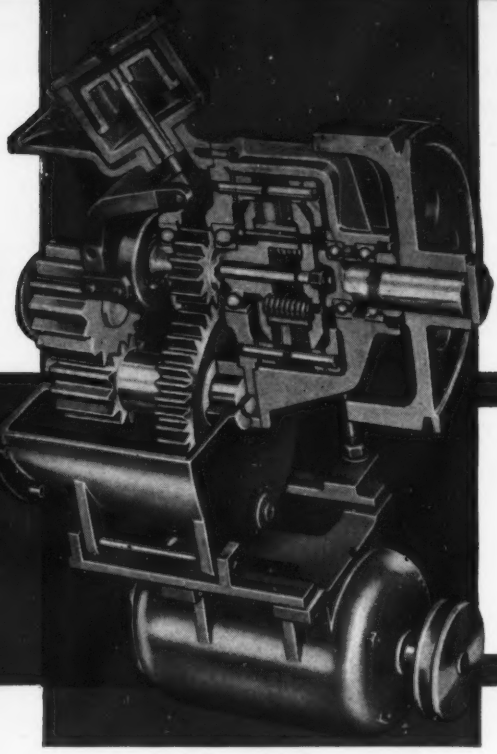

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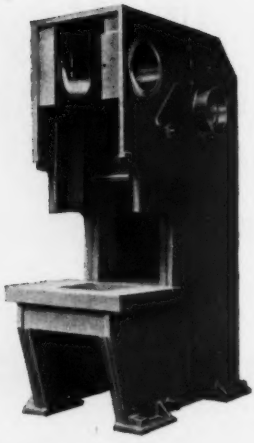
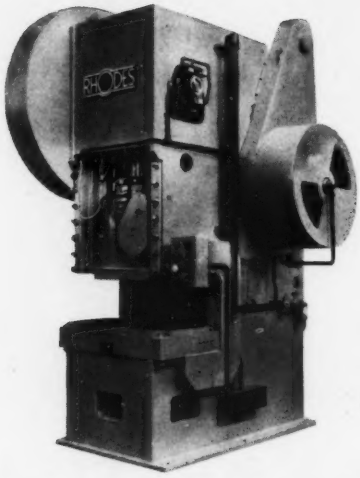
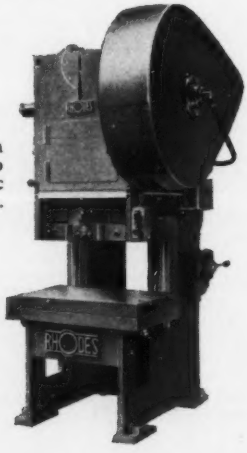




The sturdy fabricated one-piece steel frame of Rhodes C-Frame Presses is only one aspect of their merits—full details of all their constructional and operational features are contained in Catalogue RFP-60.

Rhodes RF series presses are all inclinable, up to Size RF75. Inclining mechanism can be motorised.



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RP 12

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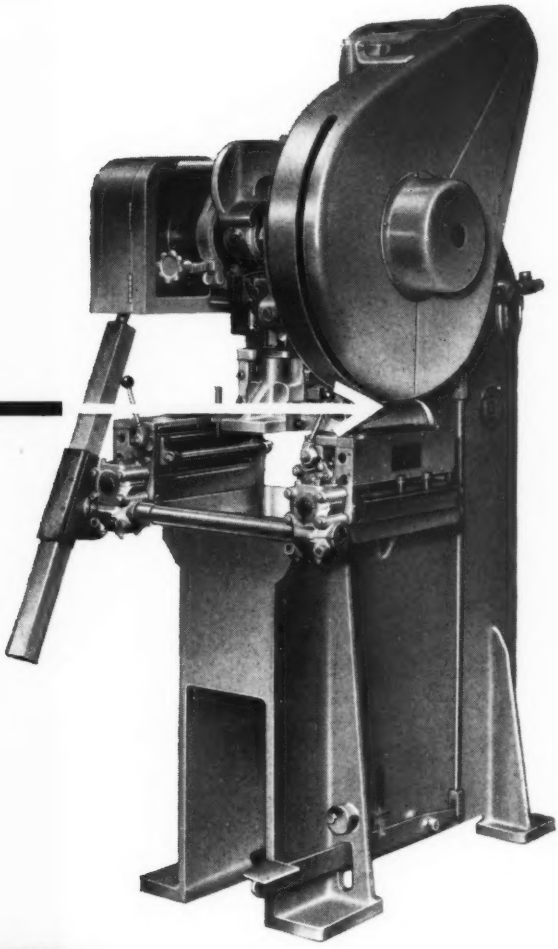

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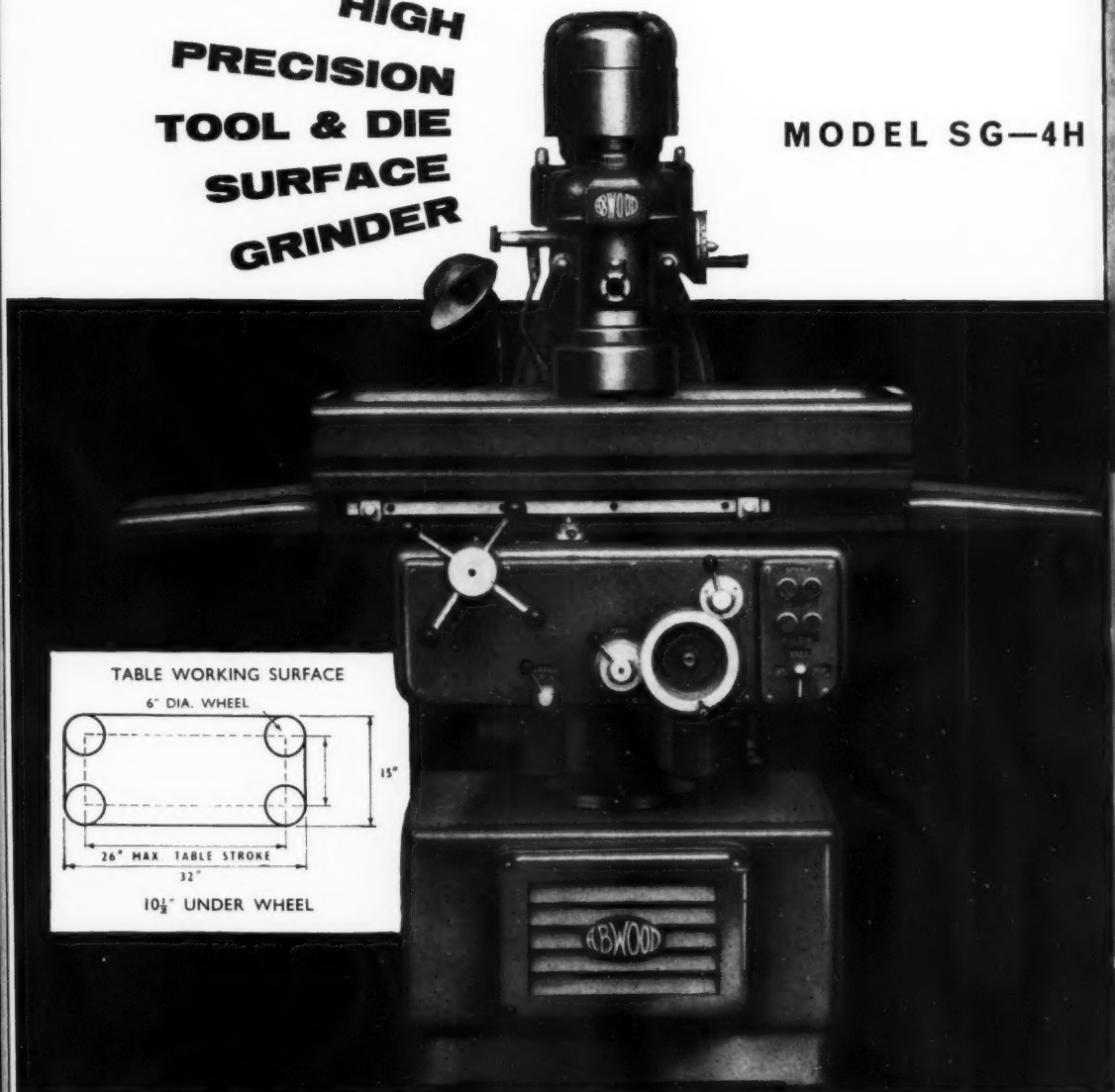

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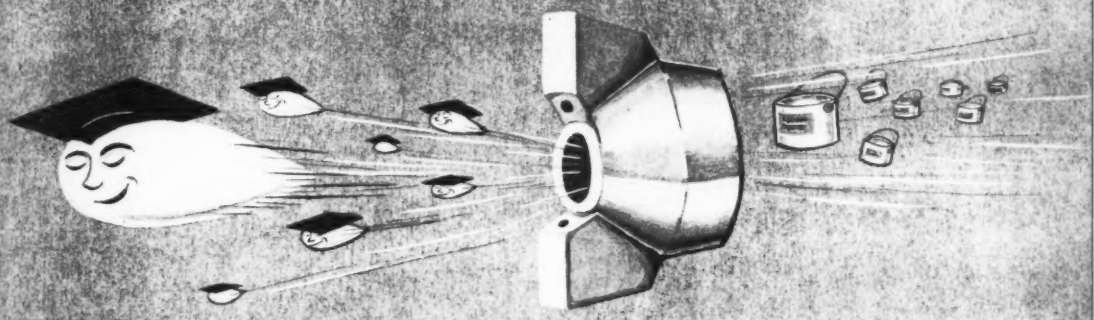

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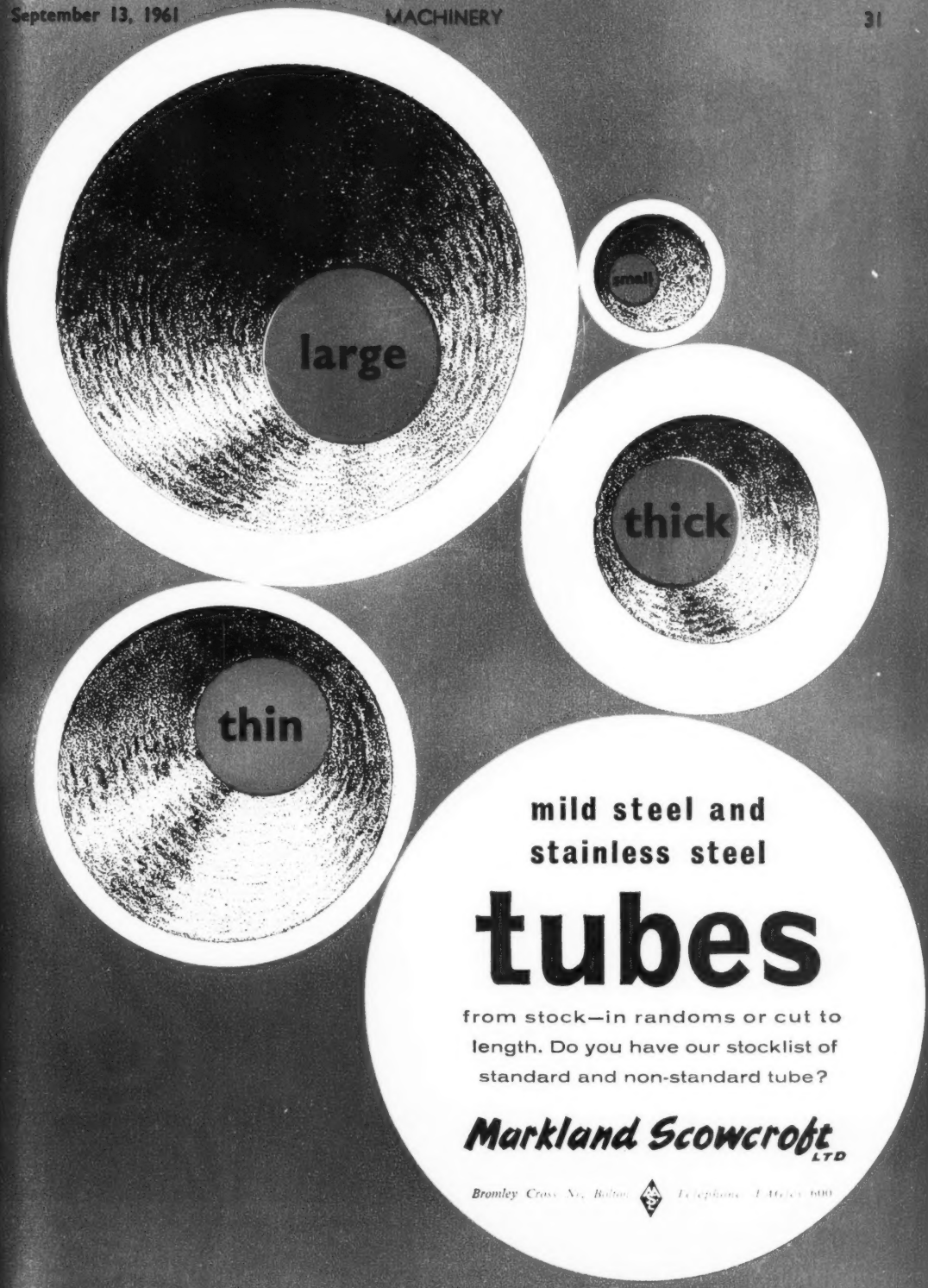
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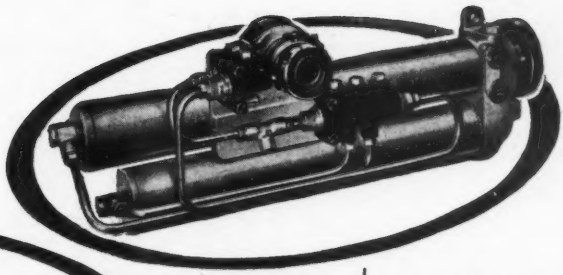

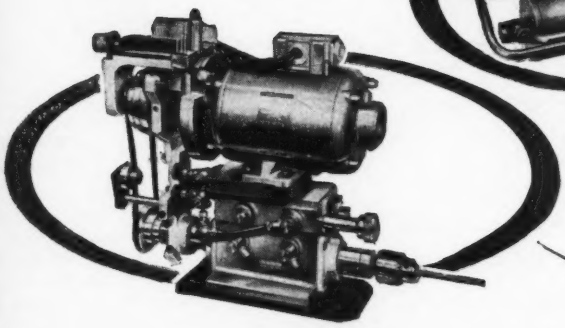

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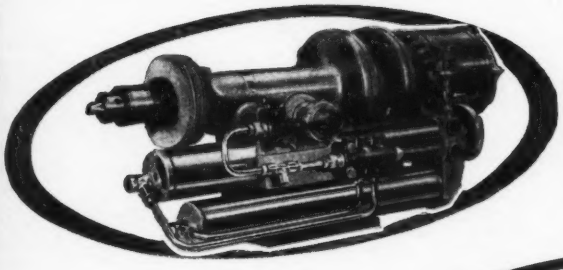

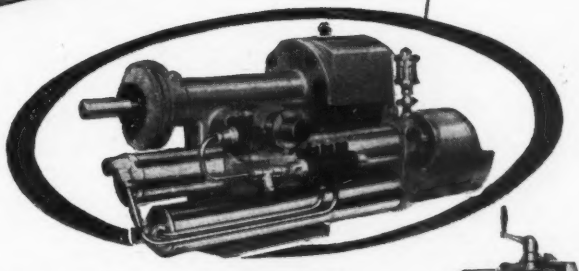

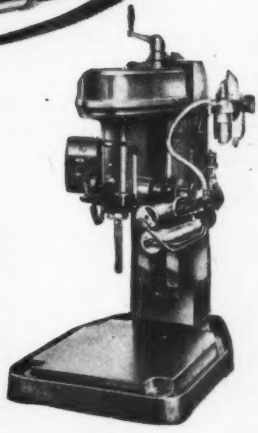

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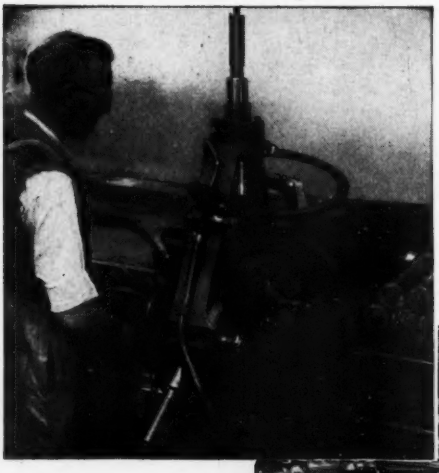

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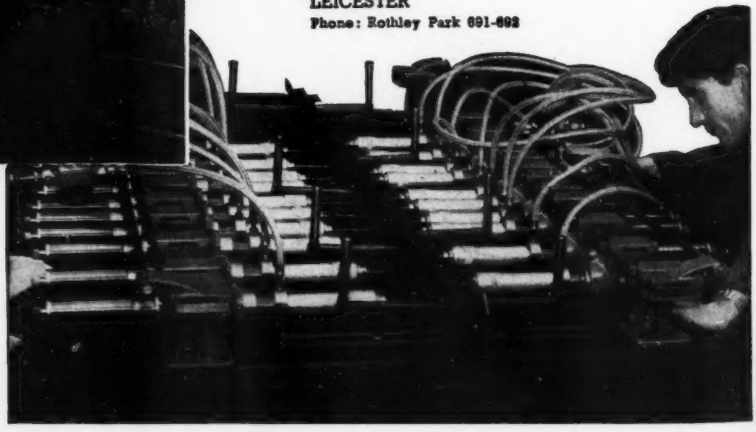

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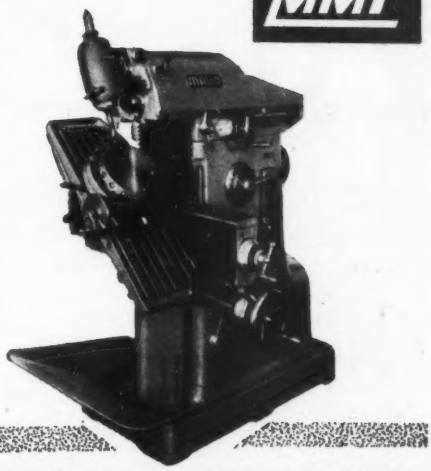

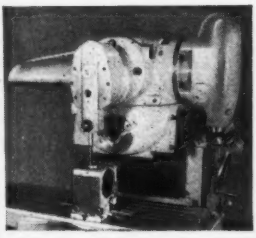

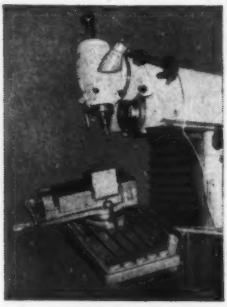

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OPTIONAL EXTRA ACCESSORIES INCLUDE . . .

Vertical milling head, slotting attachment, high speed vertical milling head, rotary table, fixed swivelling and tilting, and swivelling tilting and inclinable tables, punch milling attachment, dividing head and spiral milling attachment, and on the larger models power fed vertical milling attachment will be available. It is also possible on the MAHO model MH.800 to fit this machine with hydraulic copying equipment, and on the model MH.1000 HEID electronic copying equipment is available.

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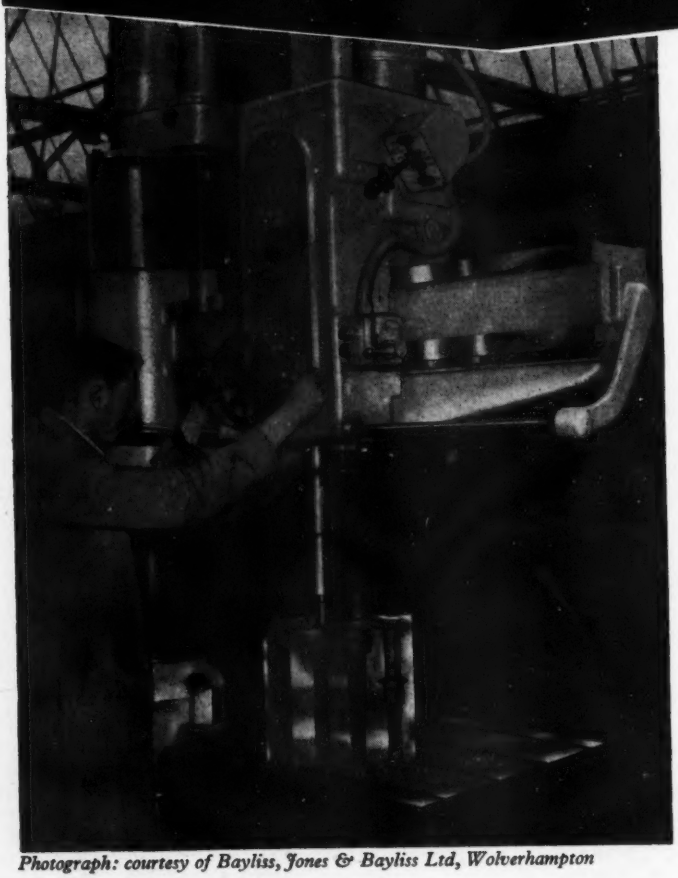

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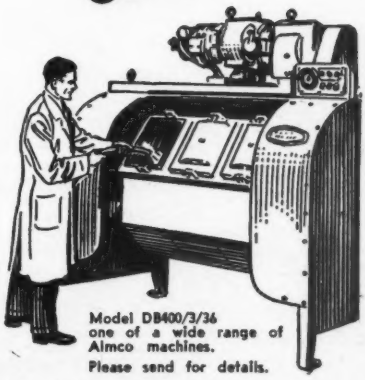

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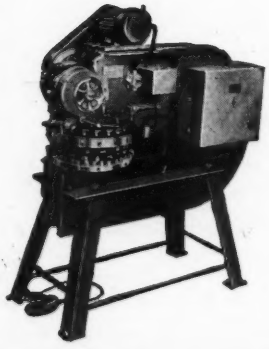
Throat depth 28" ... 1 HP. Motor
16, 18 or 20 turret stations

There's a Wiedemann Turret Punch Press for every short and medium run piercing job. Hand or power — 15,000 to 160,000 lb. punching pressure.



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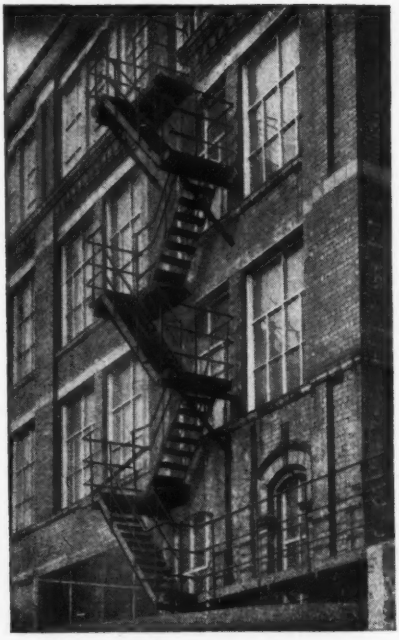

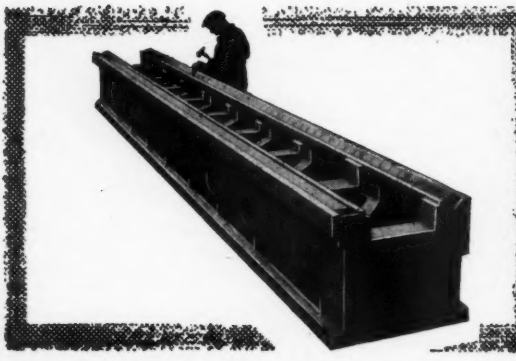

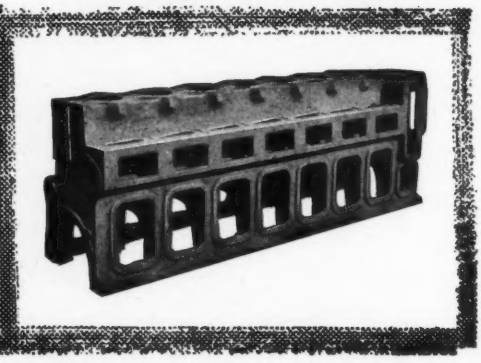

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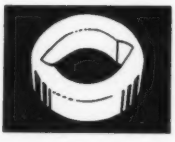

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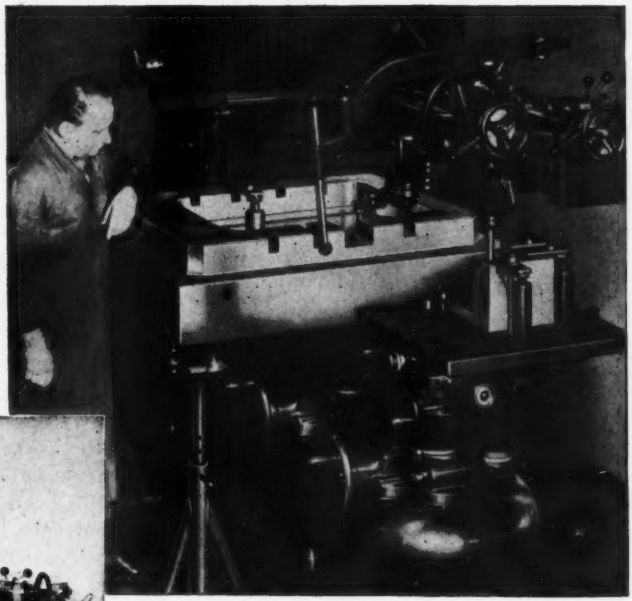

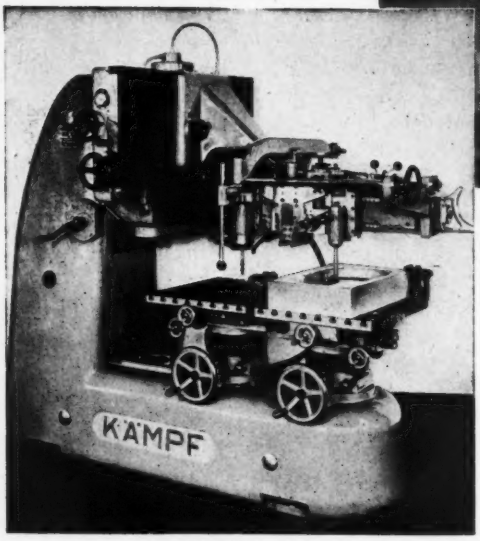

* Profile milling radii into a die, size 43" x 33½" x 14", weight 2½ tons. Material 70 ton tensile steel.

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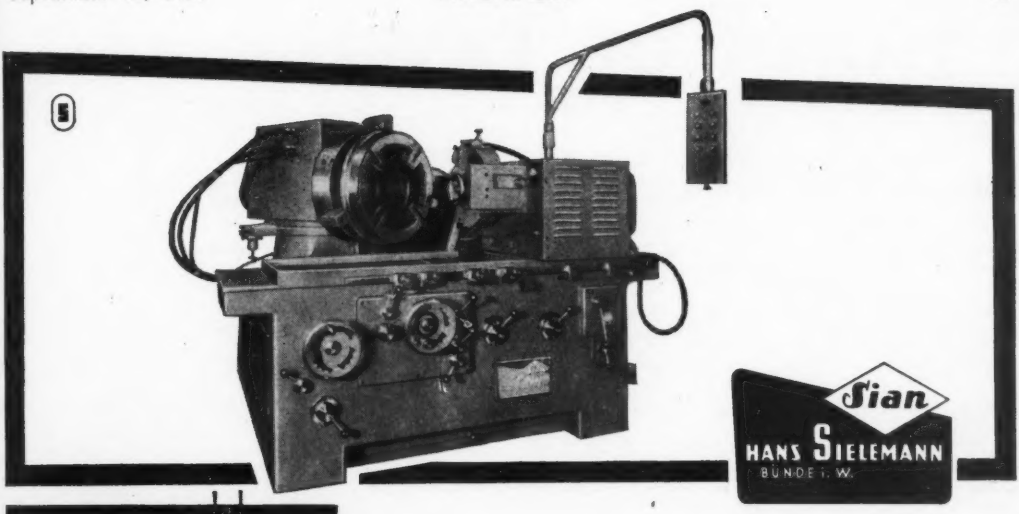

Fig. 1 **Automatic, Hydraulically Controlled Cylindrical, Face and Internal Grinding Machine, Model "RPB"**

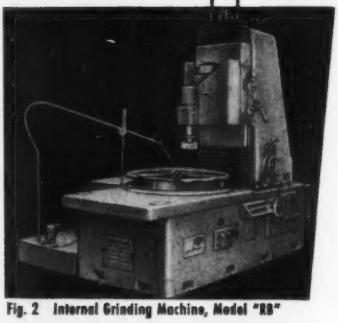

Fig. 2 Internal Grinding Machine, Model "RB"

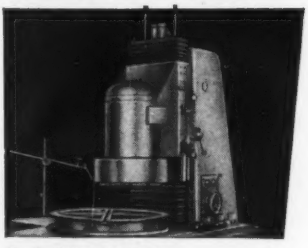

Fig. 3 Rotary Table Surface Grinding Machine Model RF

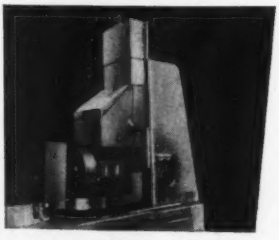

Fig. 4 Rotary Table Surface Grinding Machine, Model RF-Pe.

- Several grinding operations, i.e. Cylindrical-, Surface-, Taper- and Internal Grinding on one component are done in the same mountings, thus avoiding separate clamping times for each grinding operation (Fig. 1)
  Range of Application: Up to 50" component diameter.
- Model "RB" (Fig. 2) is suitable for heavy components
  Range of Application: Internal grinding up to 48" diameter
  Length of bore up to 20"

  Lower situated surfaces can be ground.

  Cylindrical grinding with internal grinding spindle. Dimensions of spindle accordingly.
- Model "RF" Rotary Table Surface Grinding Machine with segmental head (Fig. 3)
- Model "RF-Pe" Rotary Table Surface Grinding Machine with periphery grinding wheel (Fig. 4)
- The Types "RB" - "RF" - "RF-Pe" correspond in their construction the built-up system. The grinding spindle stocks are interchangeable.
- Range of application: Surface grinding up to 52" diameter

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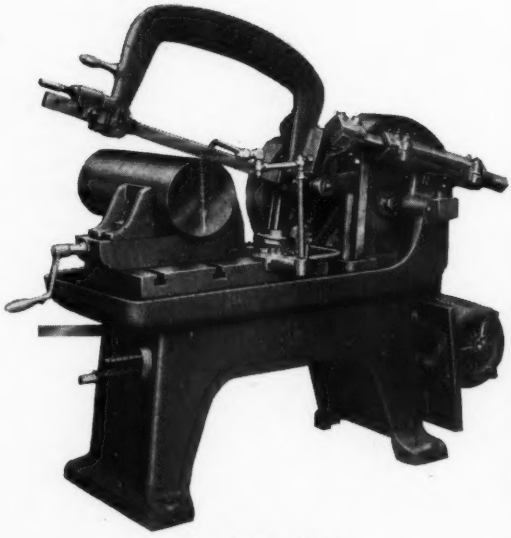

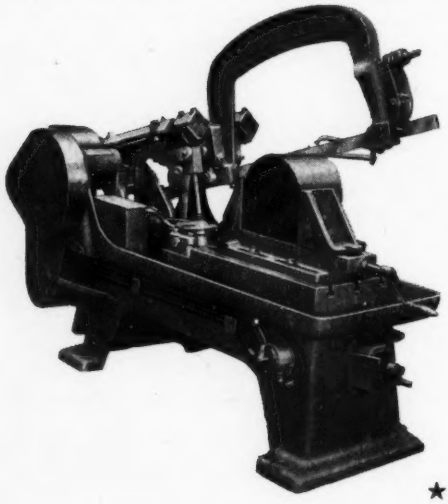

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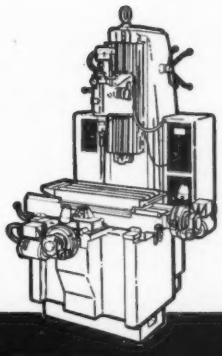

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5 millionths
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LONGITUDINAL TRAVEL:
Greatest error in any one inch
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35 millionths
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Greatest error in any one inch
15 millionths
Greatest error, entire 11"
35 millionths

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2 tenths
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20 millionths
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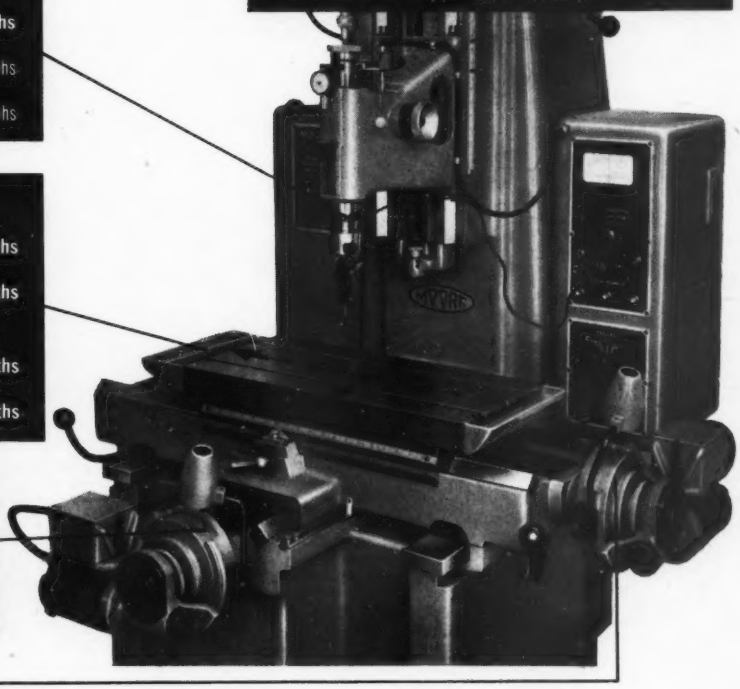
10 millionths



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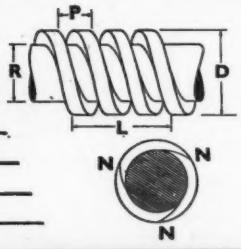
TYPE OF MATERIAL
PURPOSE



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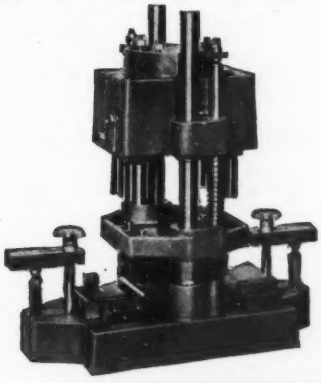

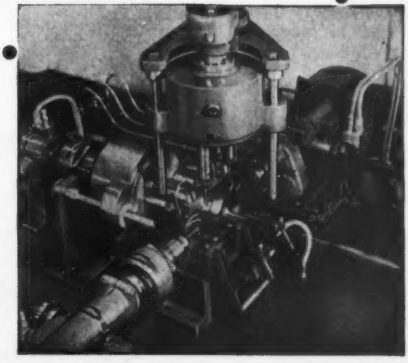

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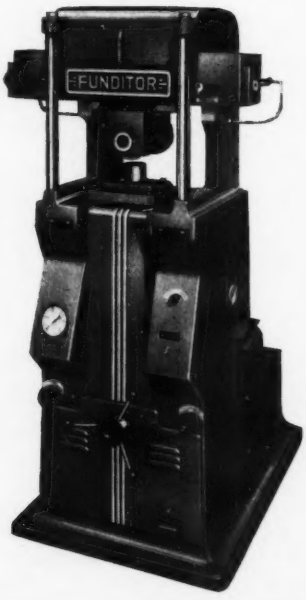

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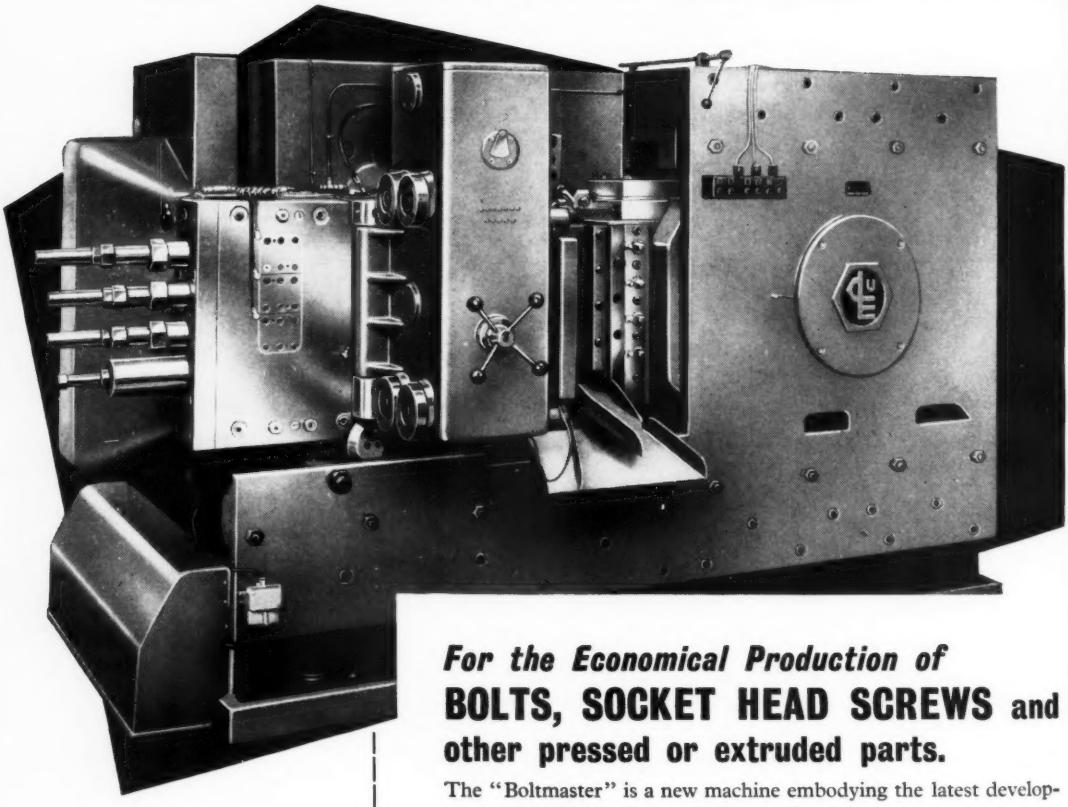

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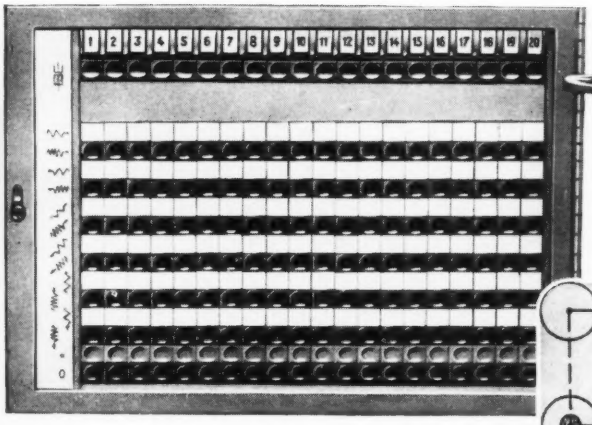
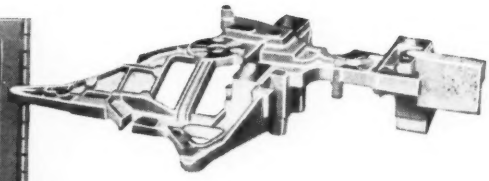
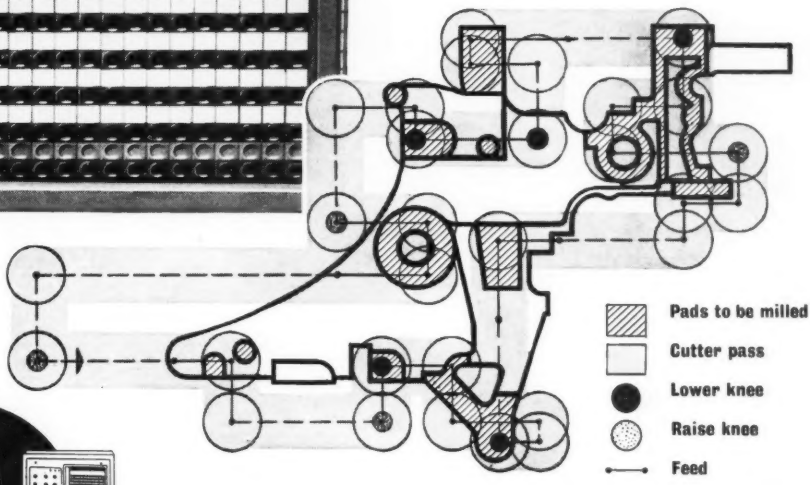
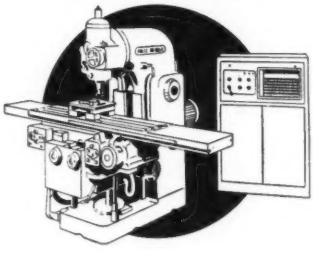






Cutter pass and rise-and-fall motions of the knee during automatic 3-dimensional programme milling of the workpiece shown above right.



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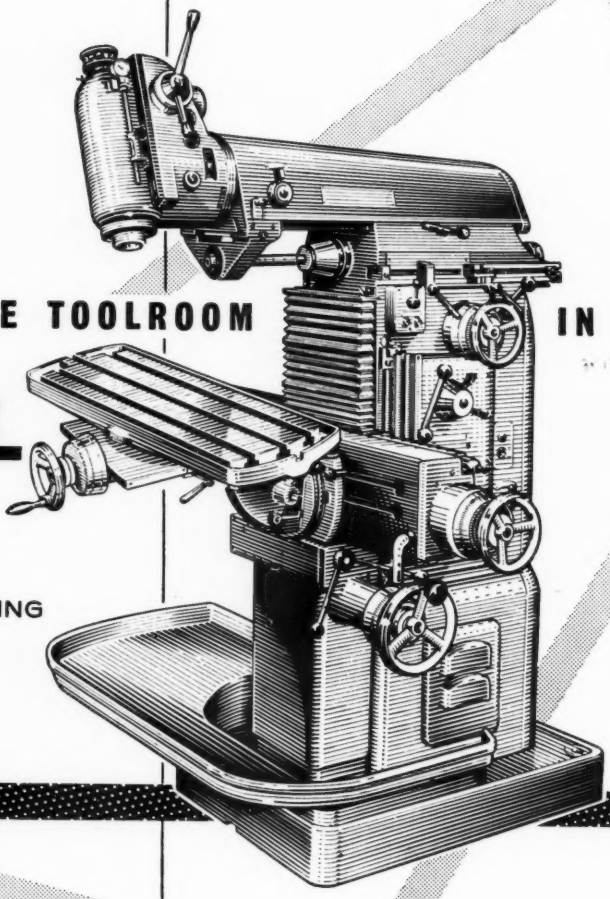

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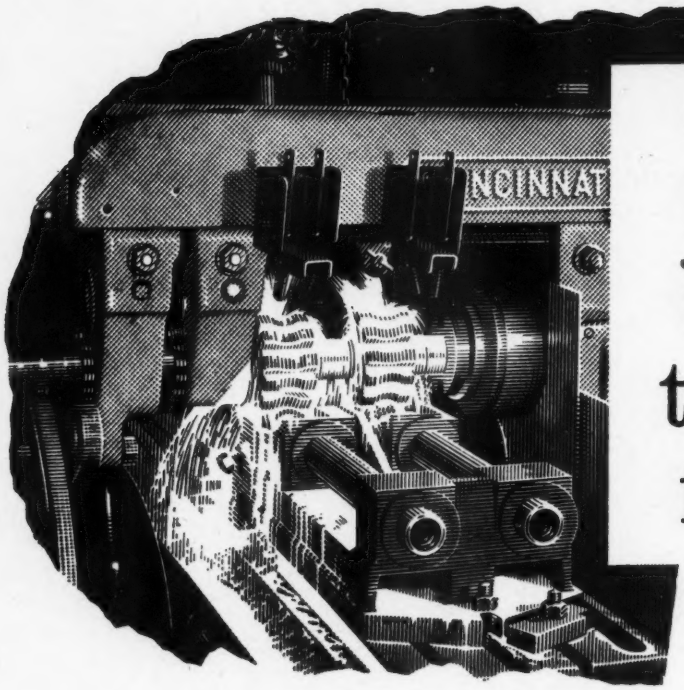

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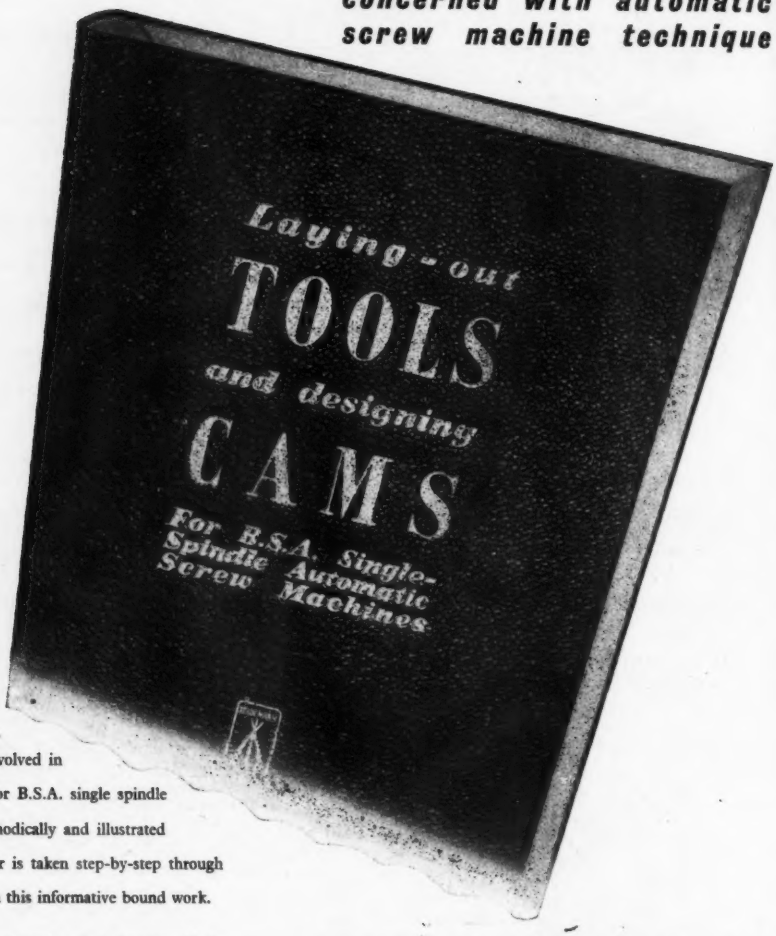
A comprehensive reference for designers, engineers and all concerned with automatic screw machine technique



Procedure and calculations involved in cam design and tool layout for B.S.A. single spindle automatics are described methodically and illustrated diagrammatically as the reader is taken step-by-step through typical production examples in this informative bound work.

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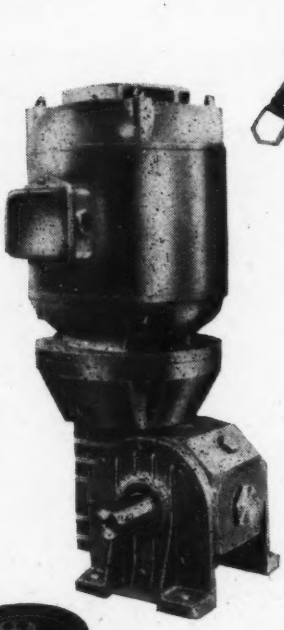

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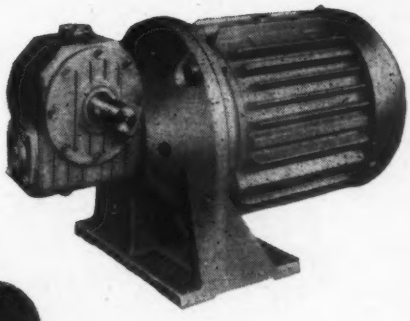

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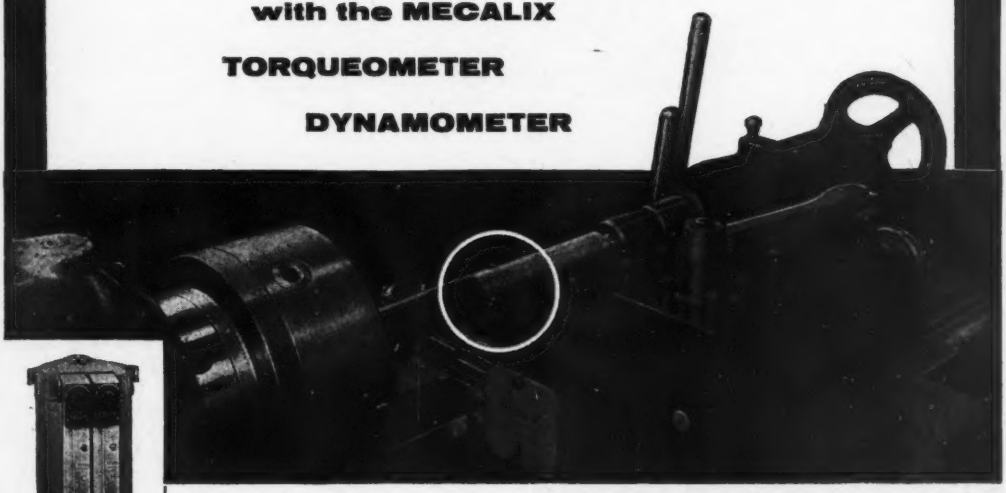

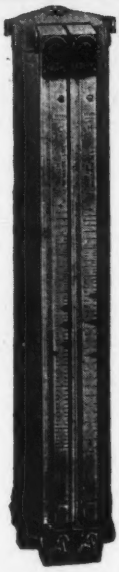

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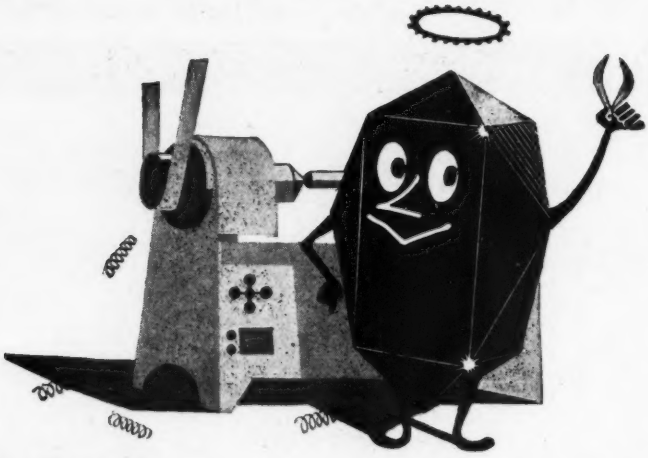
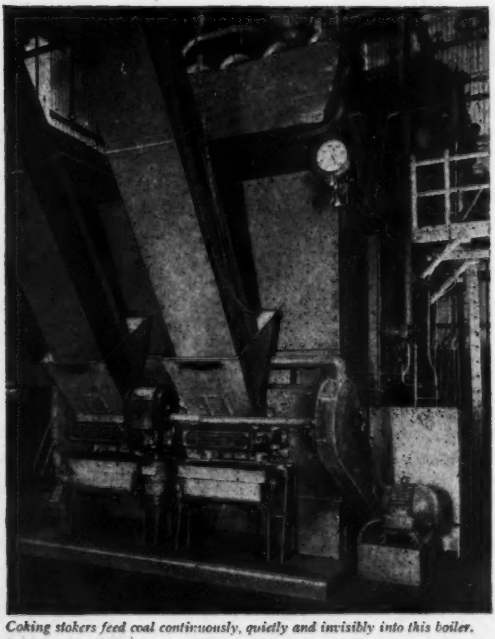


COAL-properly used- is the cheapest fuel for the Light Engineering Industry



Coking stokers feed coal continuously, quietly and invisibly into this boiler.

Much of the prosperity of Britain rests upon the growing strength of the Light Engineering Industry—an industry that embraces both small workshops and the vast and complex factories employing thousands of people. Obviously, every light engineering works has to keep its products priced as keenly as possible in the face of the rising costs of labour and raw materials and economic pressures from both domestic and foreign competition. This calls for shrewd management and the sound assessment of every possible economy on a long-term basis.

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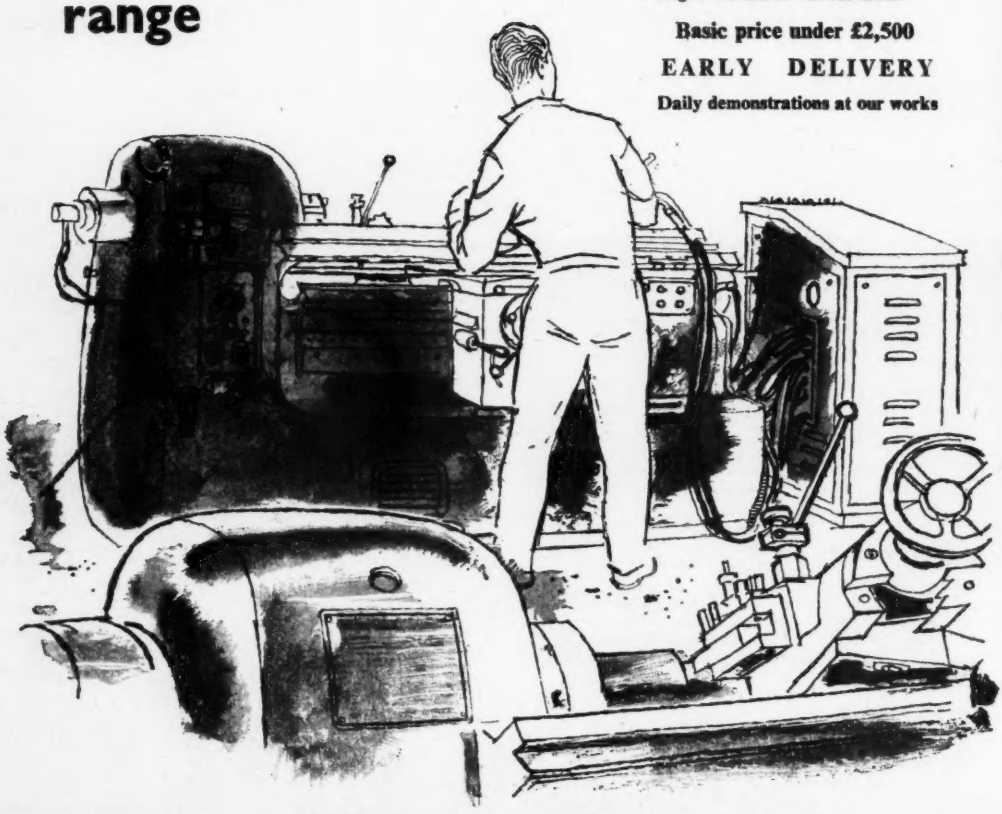

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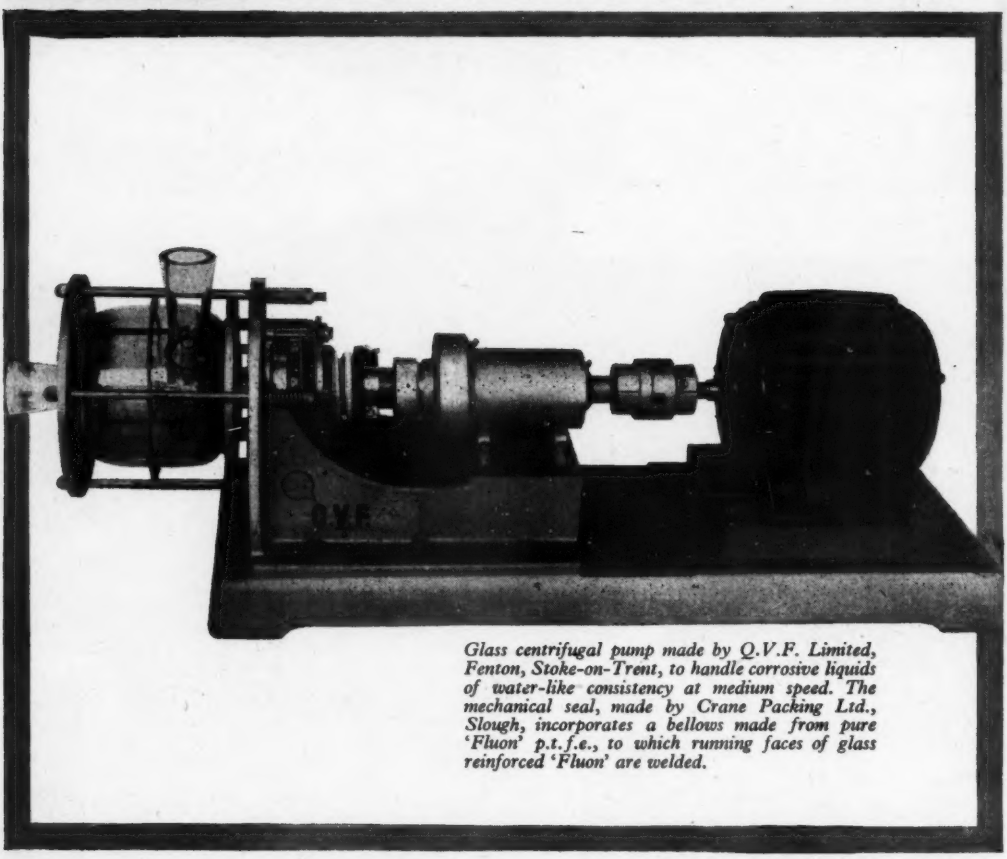

Glass centrifugal pump made by Q.V.F. Limited, Fenton, Stoke-on-Trent, to handle corrosive liquids of water-like consistency at medium speed. The mechanical seal, made by Crane Packing Ltd., Slough, incorporates a bellows made from pure 'Fluon' p.t.f.e., to which running faces of glass reinforced 'Fluon' are welded.

'Fluon' bellows makes a corrosion-resistant seal for this medium speed centrifugal pump

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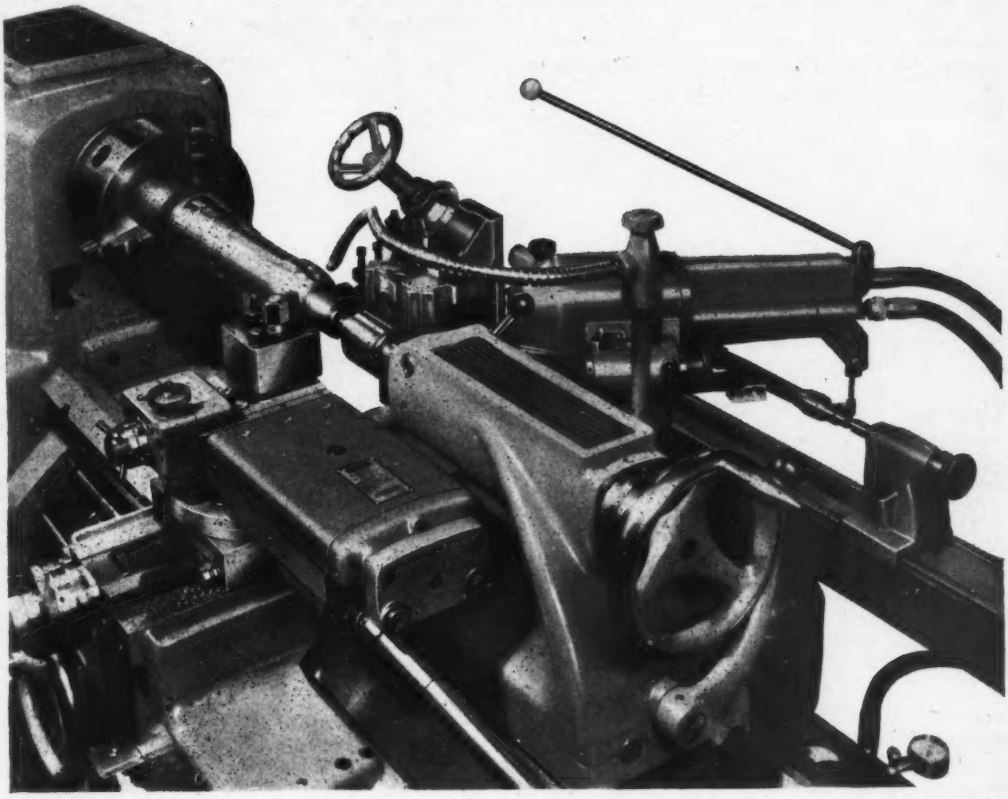

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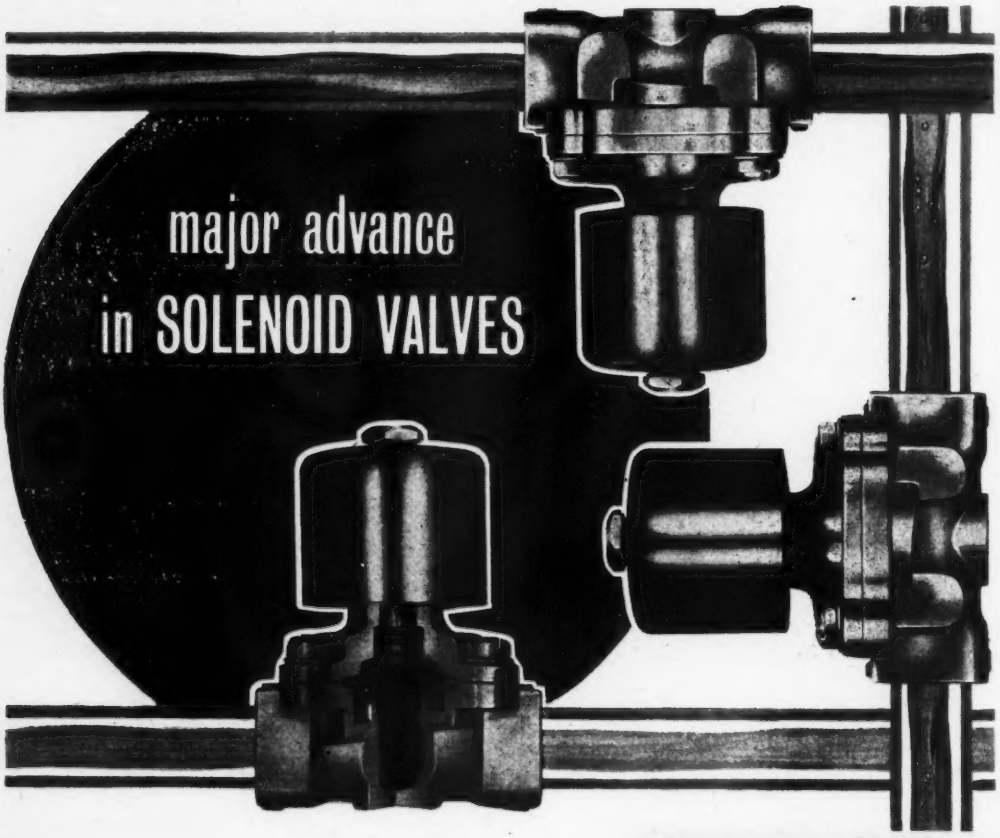

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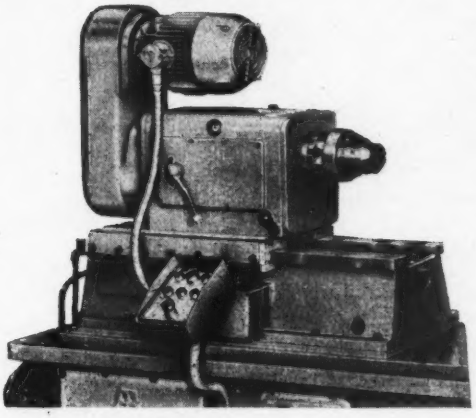

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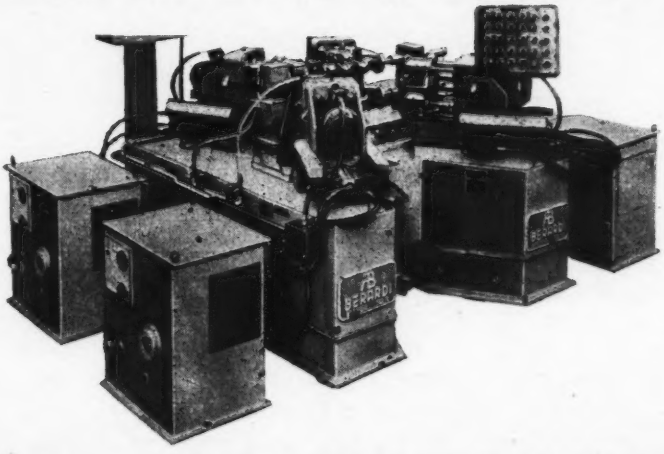

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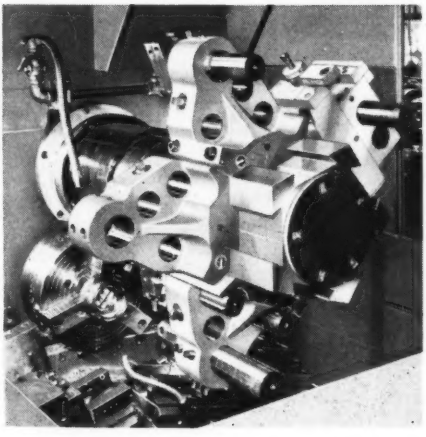

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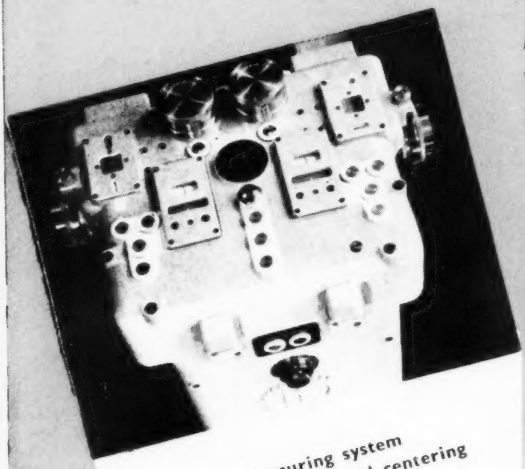

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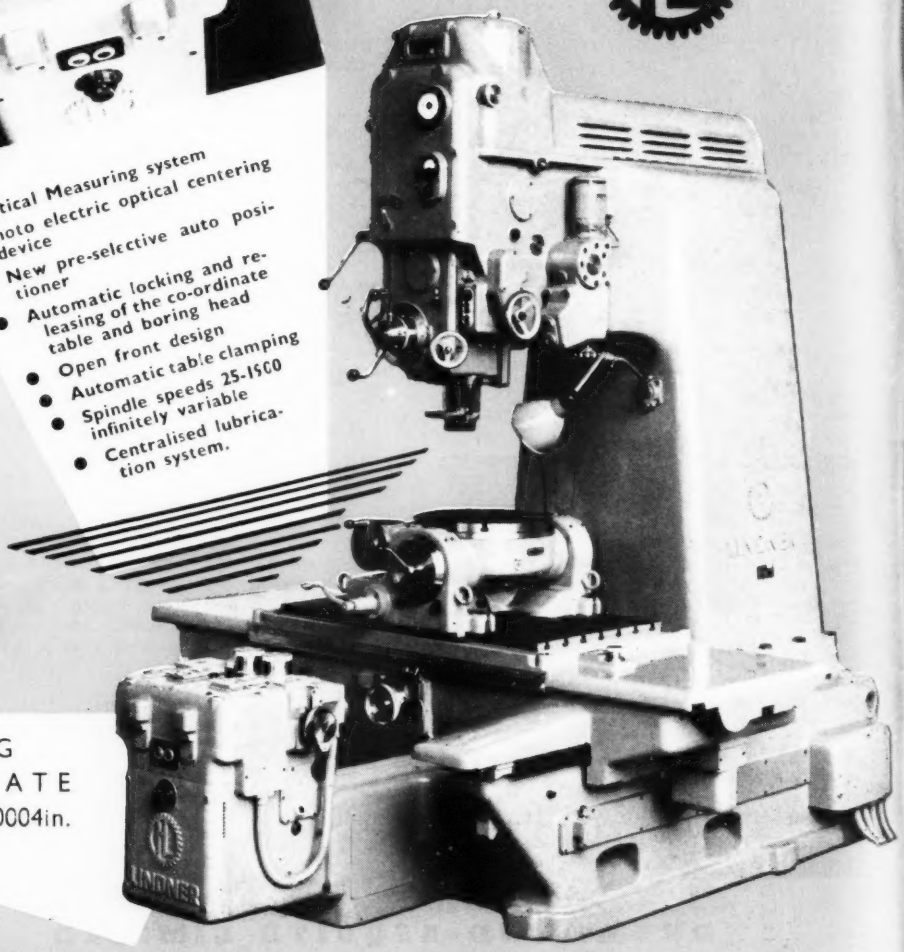

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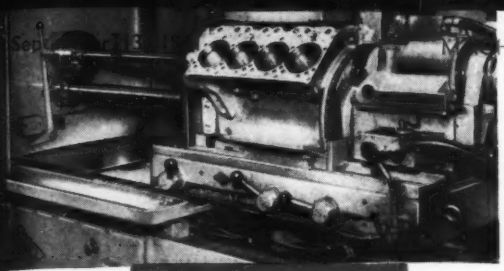
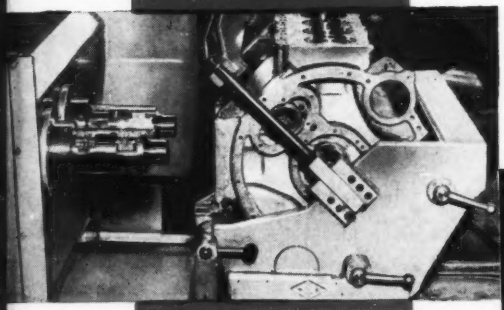
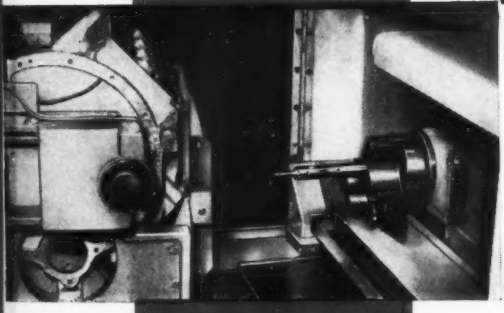


Line boring camshaft and crankshaft bores and facing, counterboring and milling of seating on end of crankcase.



Finishing liner bores including grooving operation.



Boring and milling on drive take off holes and faces.

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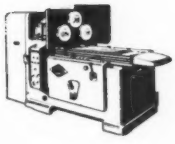

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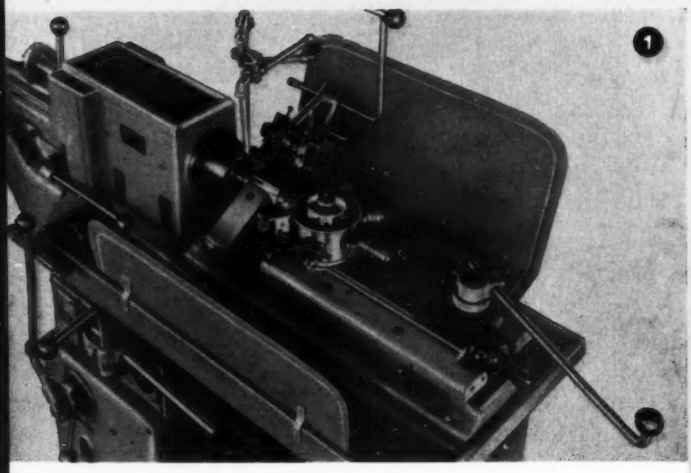
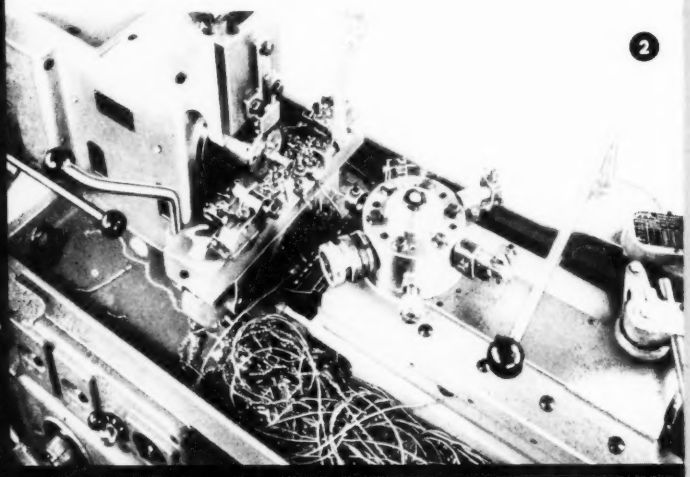
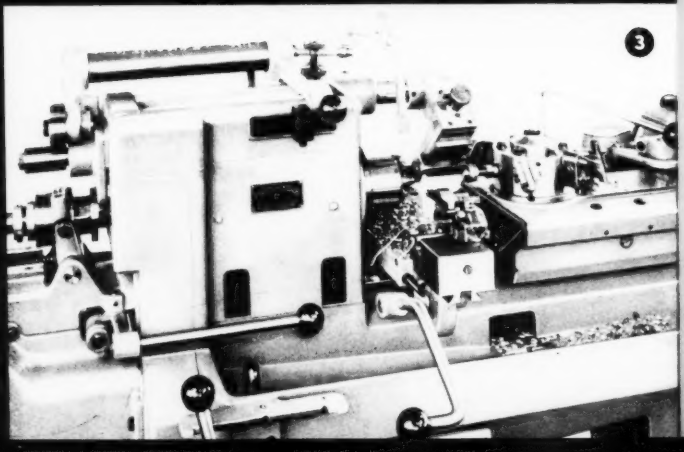
Capstan Lathe, Model RE 25







A Hahn & Kolb Design

Max. diameter of bar work 1"

Max. diameter of chuck work $4^{5}/_{16}$"

Max. spindle speed 4000 rpm.

The illustrations show:

① Model RE 25 with supplementary facing turret.

② Standard machine equipped with main turret and with vertical and cross slides.

③ Model RE 25 equipped with thread chasing attachment.

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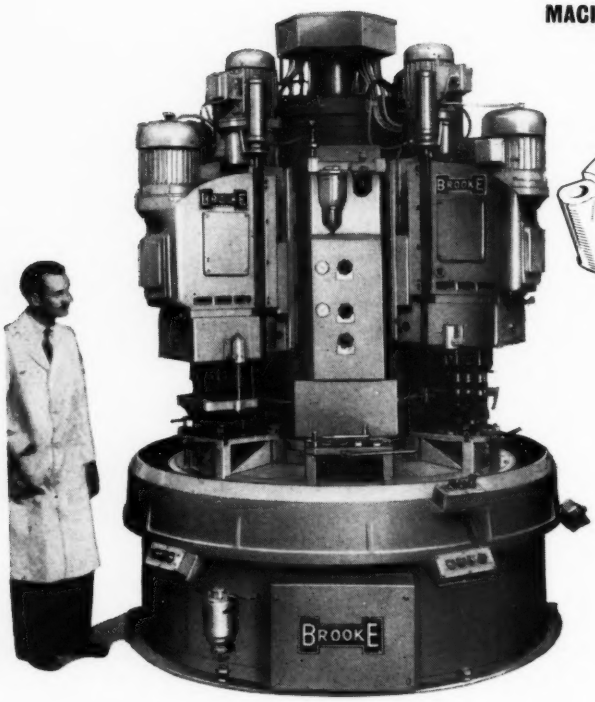
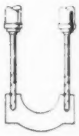
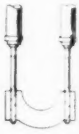


Station 1 **LOAD**

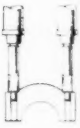
Station 2 **DRILL** 2 holes ½ depth



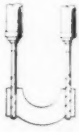
Station 3 **DRILL** 2 holes break through



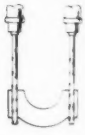
Station 4 **SPOT FACE** bearing faces



Station 5 **CORE DRILL** open 2 bolt holes



Station 6 **REAM** 2 bolt holes



★ This compact space and time saving machine employs four BROOKE UNIT HEADS. Model UH.O and one Model UH.1. Note the complete accessibility of the Heads and Tooling.

We shall be pleased to demonstrate how these fast, accurate and durable machines can help your production.

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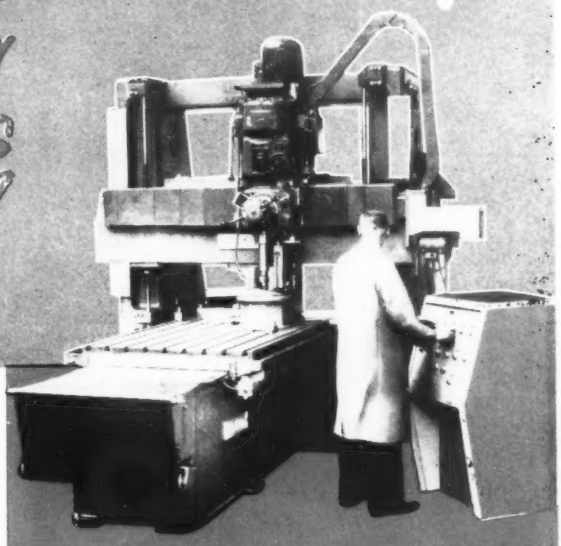
AIRMEC AUTOSET

Gets those Drilling Jobs taped



AUTOMATIC PRECISION DRILLING (LARGE SCALE OR SMALL) WITH THE AIRMEC AUTOSET

POSITIONS THE WORK

Autoset automatic co-ordinate setting equipment provides accurate automatic control of the lead screws of a co-ordinate table. It enables the table to be positioned automatically by means of a punched tape (containing co-ordinate information for up to 400 operations) or manually by means of a series of knobs and dials.

SELECTS THE RIGHT TOOL

Facilities are provided for selecting one of up to ten tools and for controlling a large number of other variables such as tool rates, feed depths and spindle speeds.

ROBUST AND RELIABLE

No electronic valves used.

EASY MAINTENANCE

Autoset has been designed for trouble-free service and easy maintenance.

CUTS OUT ERRORS

Autoset is highly accurate—automatic compensation is provided for table backlash and cumulative lead screw errors.

CUTS THE COST

An equipment for automatic control in two dimensions including tape punch with tape reader, costs only £1,630. Manual control considerably less.

Autoset fitted to Wadkin TCD. Full details available from Wadkin Ltd., Green Lane Works, Leicester.

Descriptive leaflet No. 186 on request.

Airmec

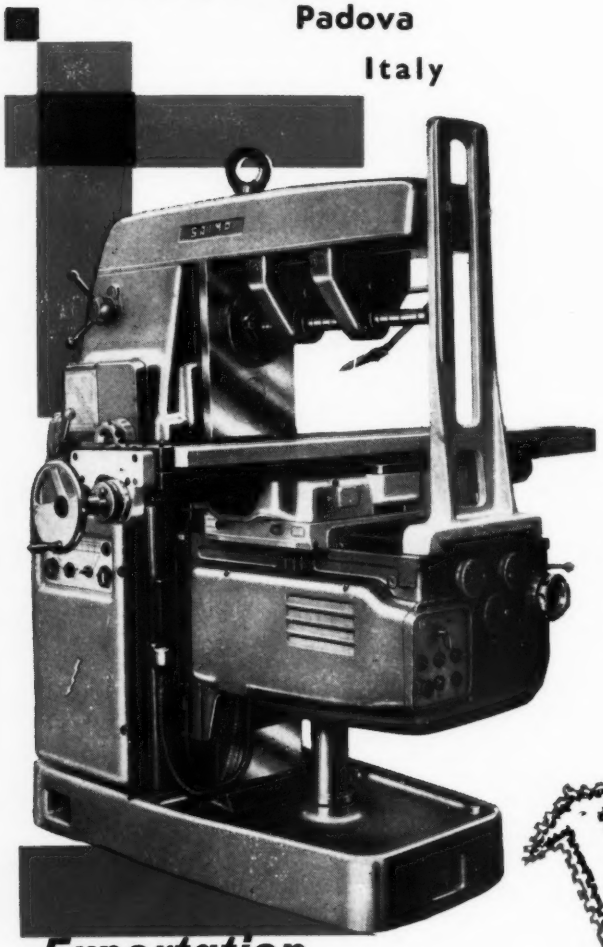
AUTOSET Low cost tape control

AIRMEC LTD. · High Wycombe · Bucks · Tel: High Wycombe 2501/7.

SAIMP

Padova

Italy



SAIMP will exhibit their range at the 7th EEMU at Brussels and therefore may NOT exhibit at the 39th Milano Fair

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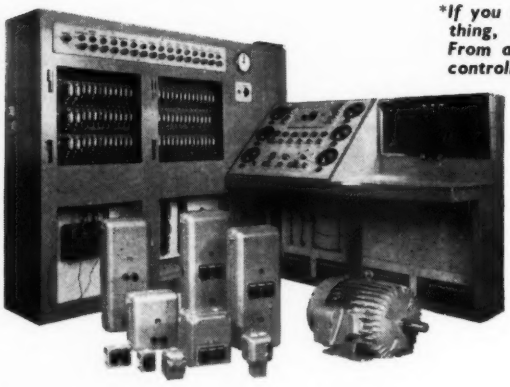

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Photograph by courtesy of The Pressed Steel Company Ltd.

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SANDVIK Coromant NEWS

3 *Increased production resources, now give us the opportunity of presenting,*

New Tool Designs

T-maX "Throw-away" cutters

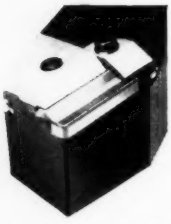
A cutter design with throw-away economy, and the versatility of a cutter with brazed blades.

Special features:—

- **Sturdy design, with easily replaceable parts.**
- **Superior economy. The cutter can be supplied with inserts of different sizes, negative as well as positive.**
- **Gives a high surface finish. The design has been specially conceived around this feature.**

T-maX Micro-blade

This revolutionary and bold idea, with a so-called "micro-blade", is now about to leave the development stage.



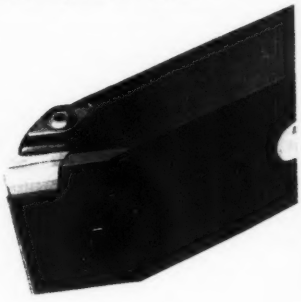
This tool, which in the first place is intended for cutting depths of over 1in., opens up new possibilities to improve machining economy within a range so far untouched.

T-maX Toolholder with Rhomboid inserts for Copy-Turning

The copy turning tool range which includes brazed tools, toolholders with long inserts, and throw-away tools of the T-maX type with triangular standard inserts, is now extended by including this new holder.

Special features:—

- **A 55° nose angle gives good accessibility with most copying operations.**
- **Robust design with sound clamping of the throw-away blade.**
- **Positive cutting rake with 0° front-to-back rake allows machining of slender work-pieces.**
- **With sintered chipbreakers—a guarantee of reliability even with the small nose angle involved.**



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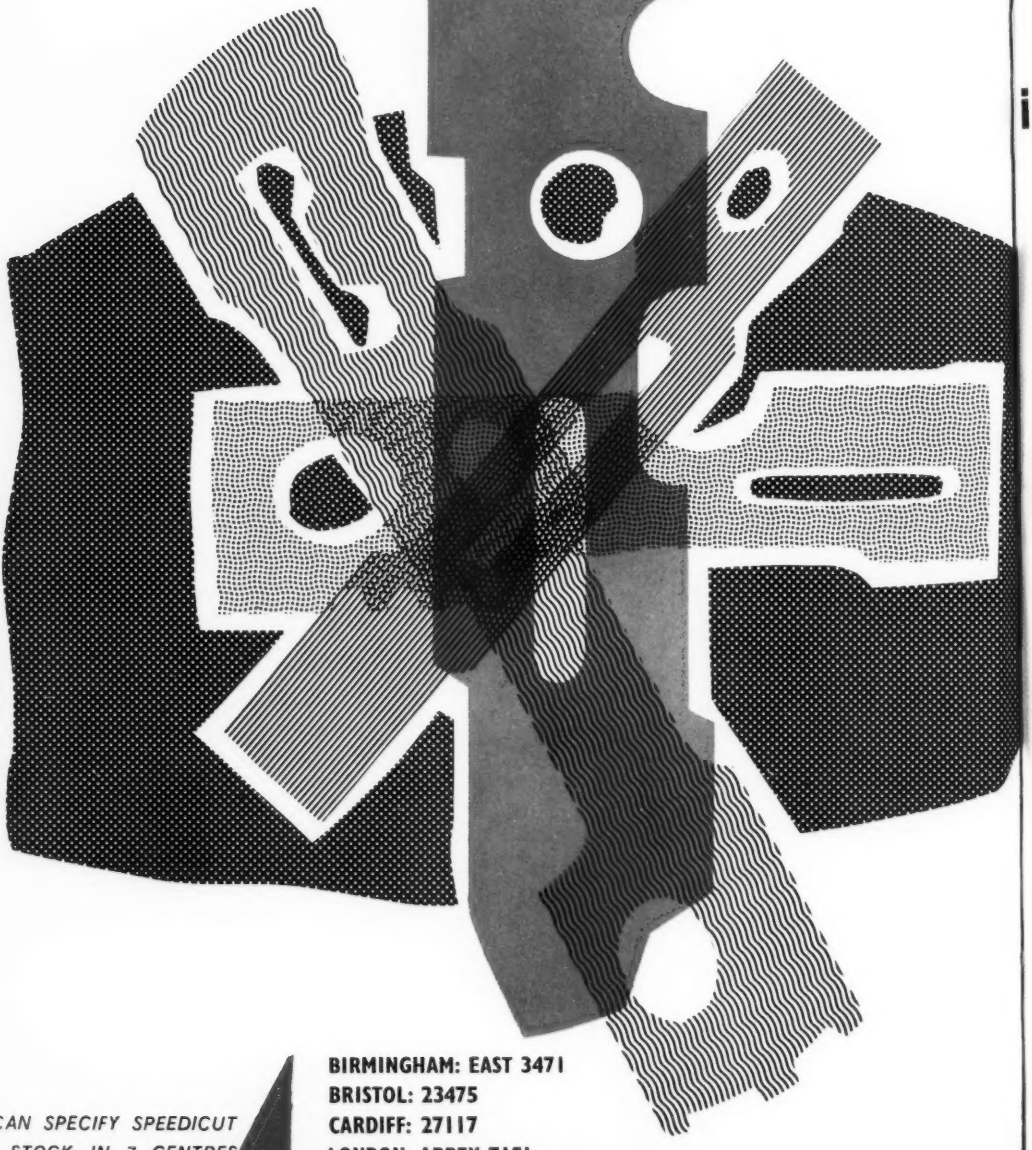

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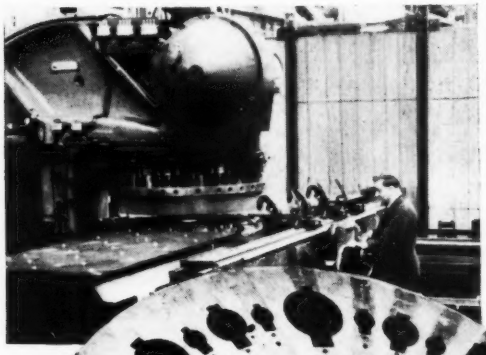

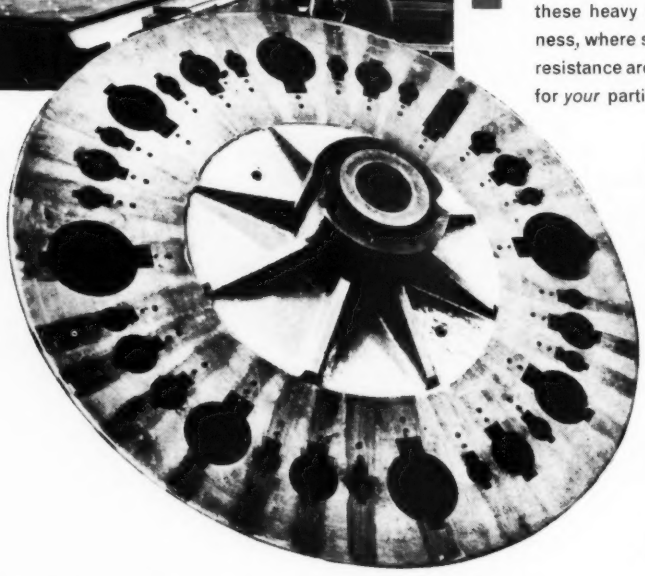

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Copy of the Meehanite Specification Booklet will gladly be sent upon request. Also available for your information are leaflets on:-

- **A4 Casting Properties**
- **A5 Designing Meehanite castings to cut production costs.**
- **A6 Machine Tools**

Press illustrated is produced by Distington Engineering Co., Ltd., for Dowding & Doll, Ltd., (Sole Agents). Castings by Cameron & Roberton, Ltd.

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BRITISH AND FOREIGN PATENTS

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- **NEW** Automatic cycling—optional extra.
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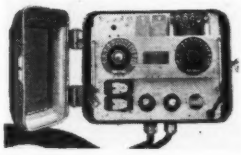

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Optional extra—New brush device (British and foreign patents) air operated, cleans and lubricates the die faces. Mounted on a swivel plate to give an adjustable angle to the brush stroke.

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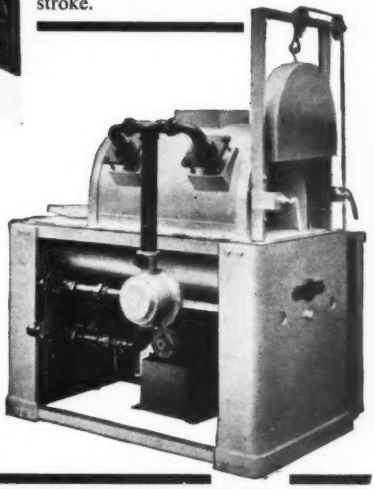

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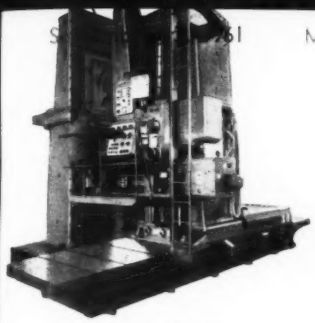

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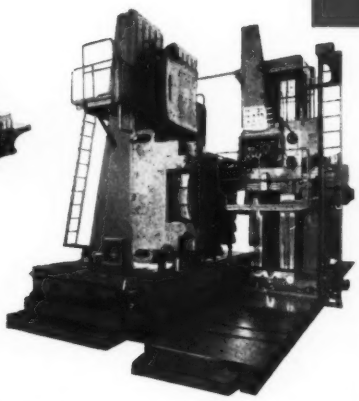

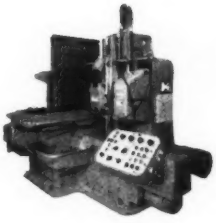

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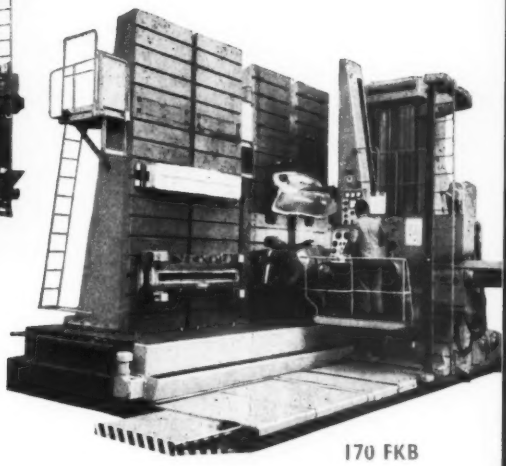

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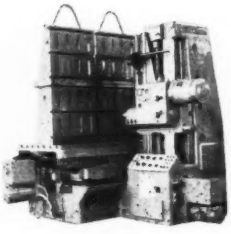

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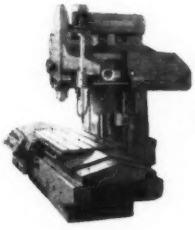

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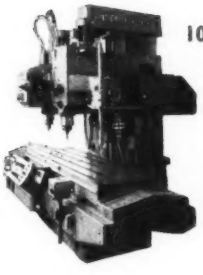
The eight basic models shown here are available with various capacity ranges, allowing the most suitable machine size for individual requirements.

All machines operate fully automatically The contact tracer follows the model and transmits the shape to the workpiece. The pattern may be made of wood, plaster plastic or sheet metal.



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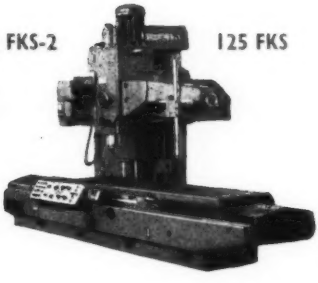

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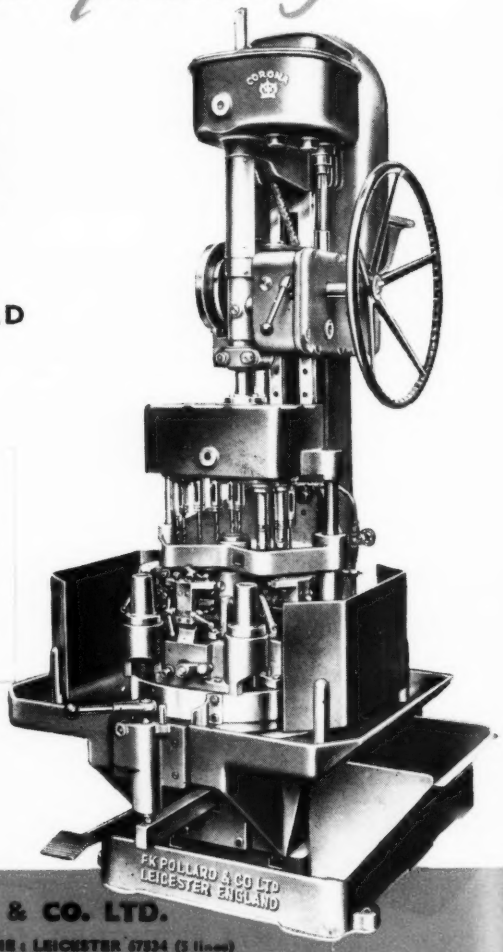

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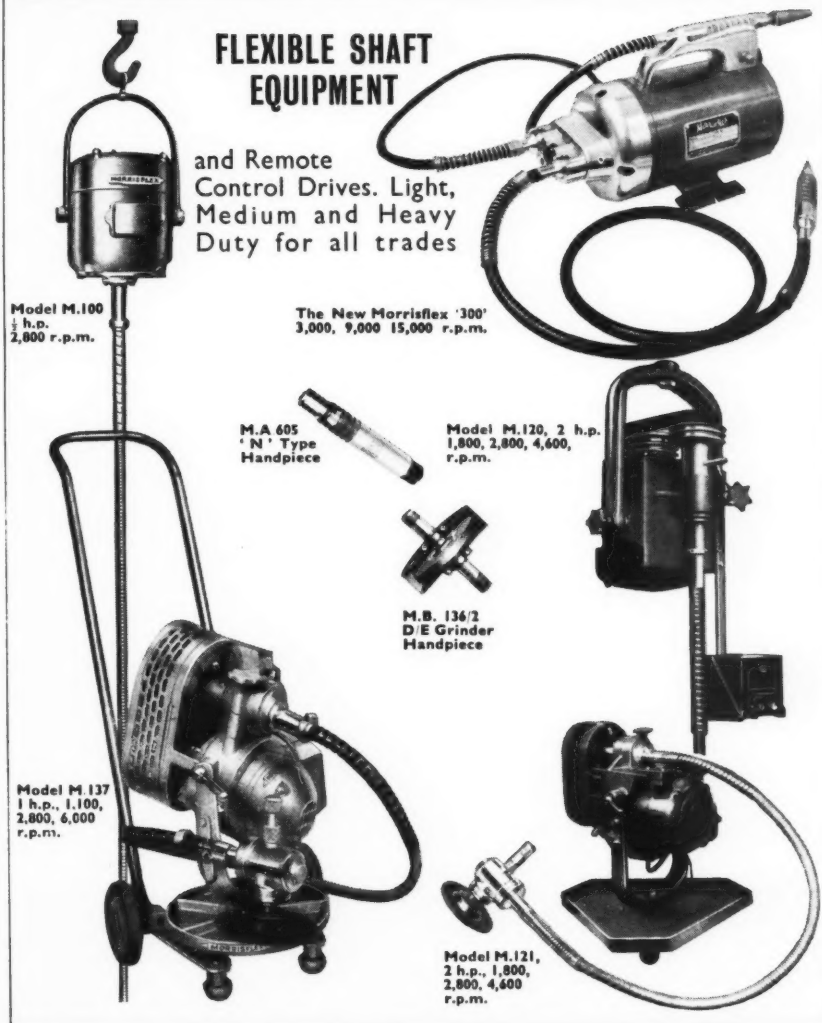

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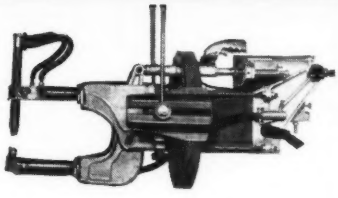

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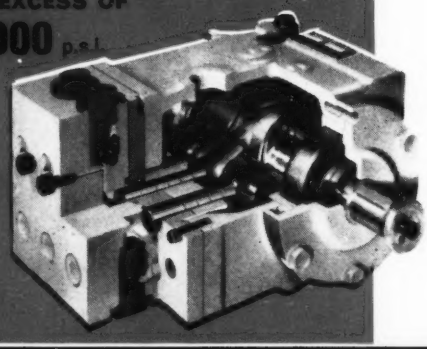

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Type BVDCR Bypass and Off loading Valve.

Type TN Directional Valve

Specification of a few of THE K.G. SERIES OF PISTON PUMPS

Type	Bore/ Stroke	Flow in g.p.m.		Cont. Service at 1500 r.p.m.		3rd Service at 1500 r.p.m.		1/10th Serv. at 1500 r.p.m.		Wt.
		1000 r.p.m.	1500 r.p.m.	max. pr. p.s.i.	Input H.P.	Max. pr. p.s.i.	Input H.P.	Max. pr. p.s.i.	Input H.P.	lb.
GVS		0.28	.43	5700	2	6500	2.5	7100	3	62
GV6	12.12	0.8	1.21	6000	6	6750	7.5	7100	8	62
	14.12	1.1	1.65	4600		5400		6000		62
	16.12	1.47	2.2	3600		4300		5000		62
GV15	16.15	1.87	2.76	5700	12	6500	15	7100	17	86
	18.15	2.32	3.53	4600		5460		6000		86
	20.15	2.97	4.4	3600		4390		5000		86
	20.20	3.97	5.83	3000		3600		4000		86

The above figures refer to the three smallest pumps in the KG range. Altogether there are nine sizes, and by varying the stroke/bore dimensions twenty-two different ratings are available. Double pump units are made up to fulfil specific requirements. Literature giving full particulars will be sent on request.

THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

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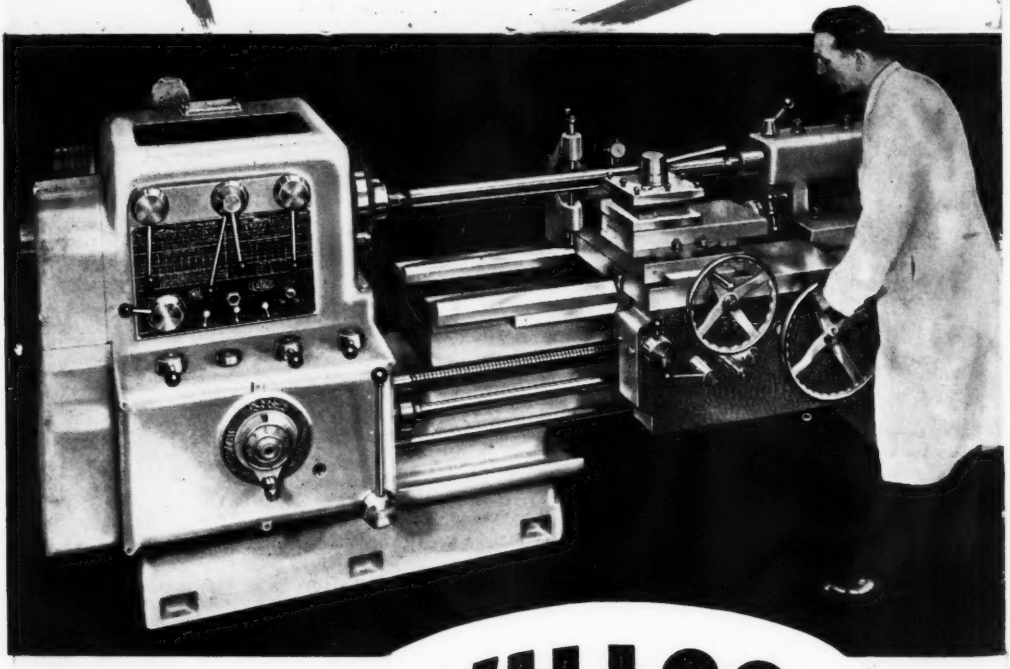

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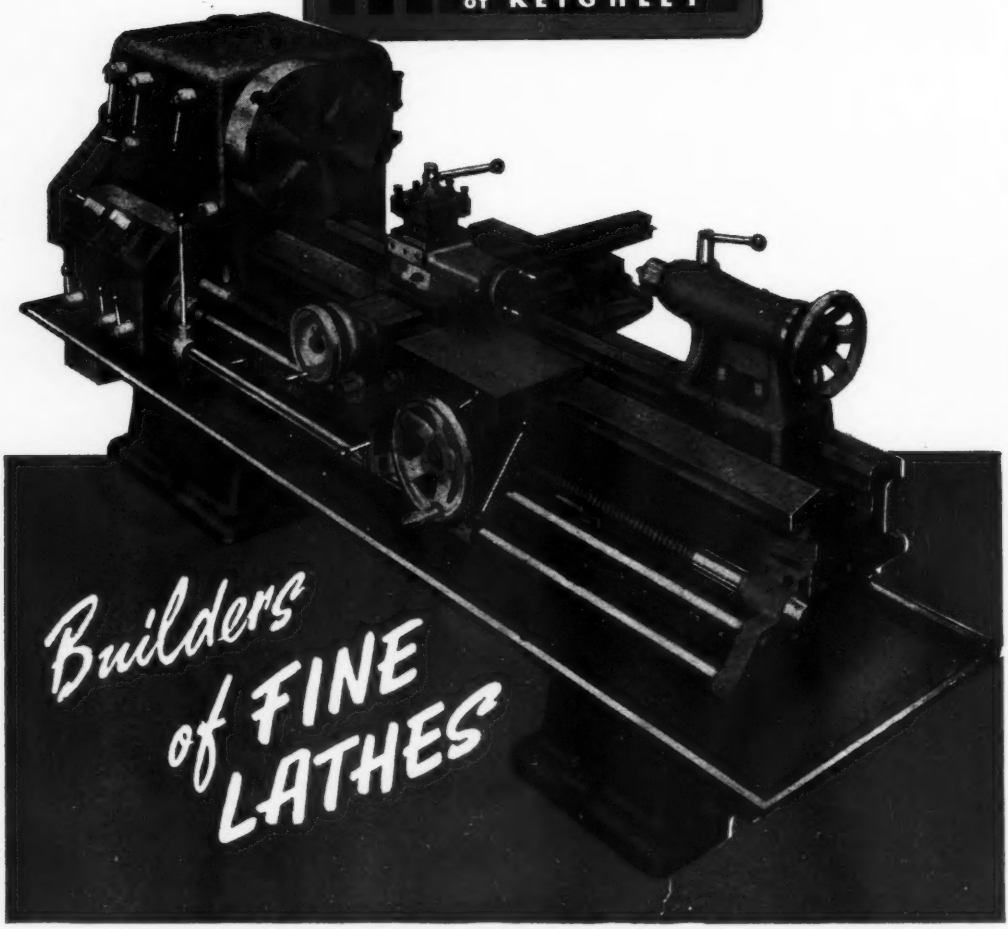

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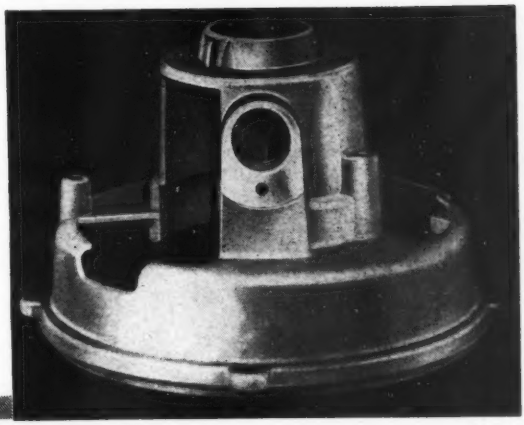

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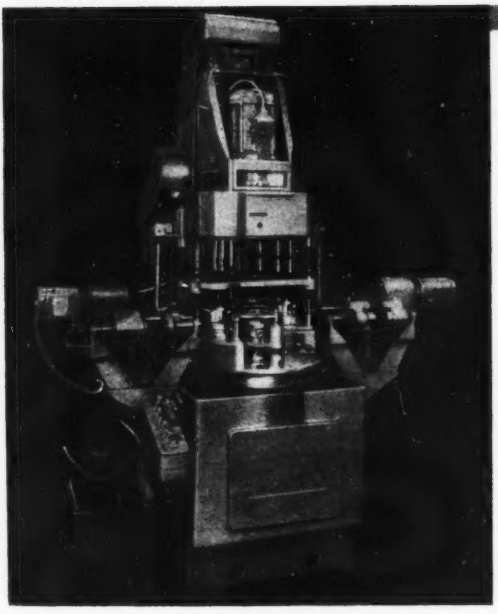

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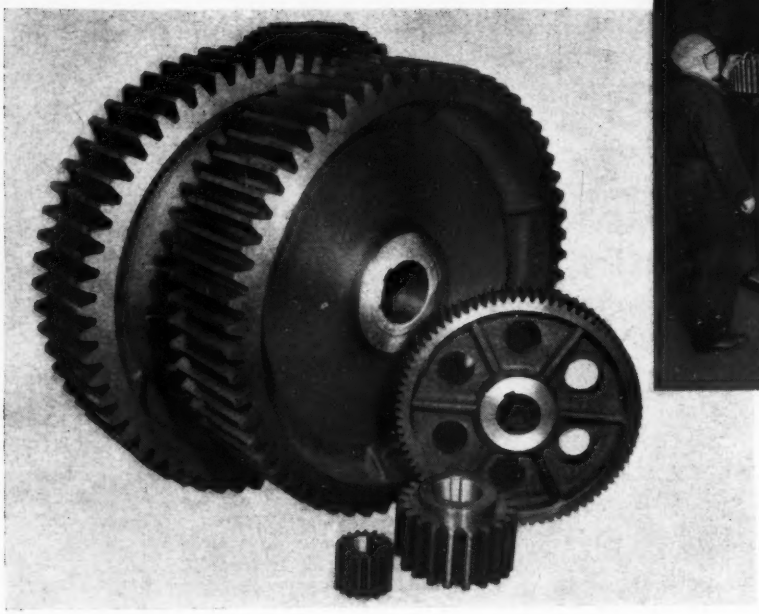

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Mechanical Model NZM 50/330
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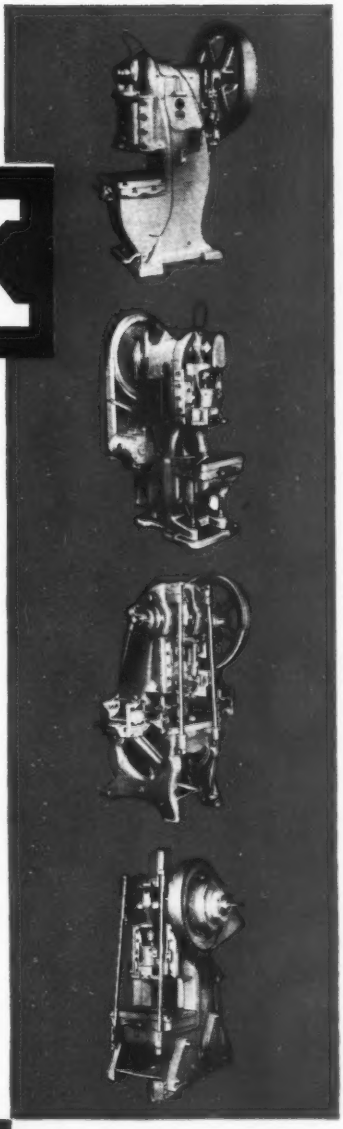

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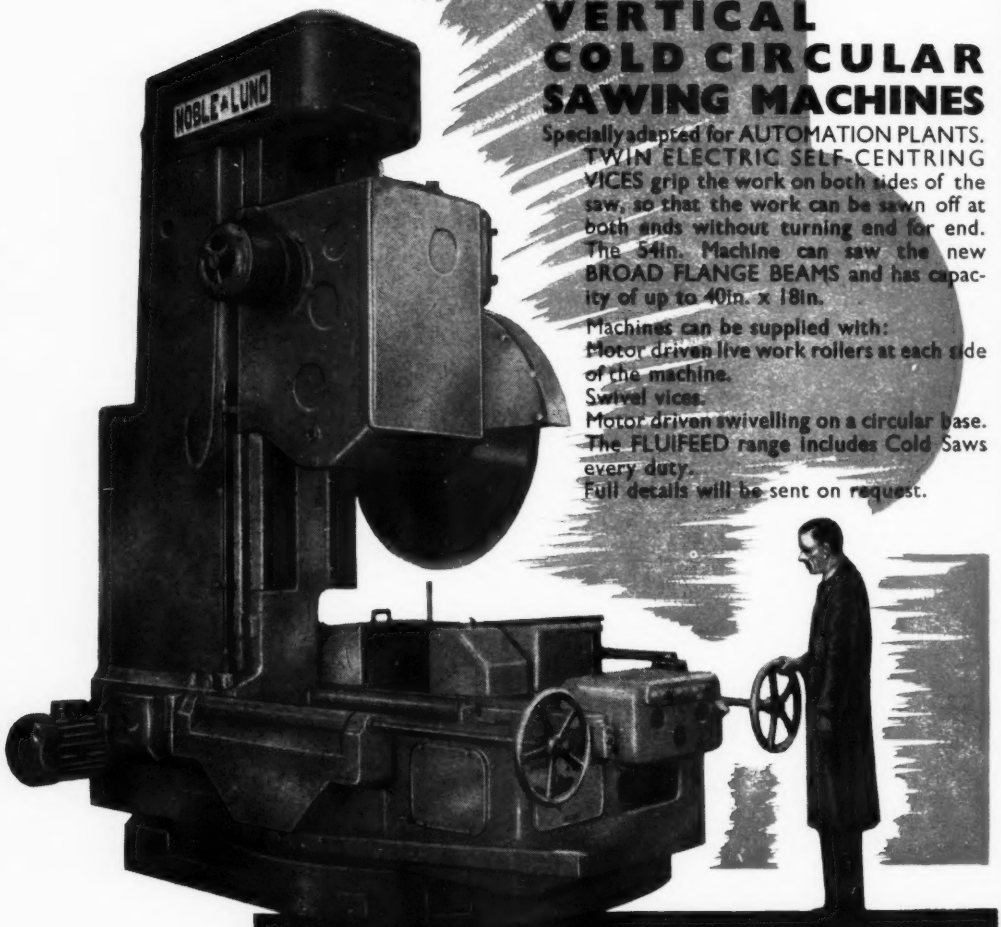

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- ☆ **Adjustable spindle thrust bearing.**
- ☆ **Automatic lubrication of table-ways.**
- ☆ **Saddle, mounted in needle-roller anti-friction ways.**

Brief Specification	618	824
Longitudinal Table Travel	20"	26½"
Transverse Movement of Saddle	7"	9½"
Vertical Movement of Wheelhead	11½"	11"
Height from Table under new wheel	10"	10"
Table Working Surface	6" x 18"	8" x 24"
Table — Hydraulic Power Traverse	125 fpm	90 fpm

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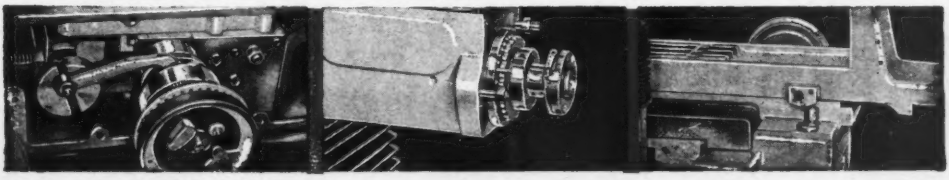

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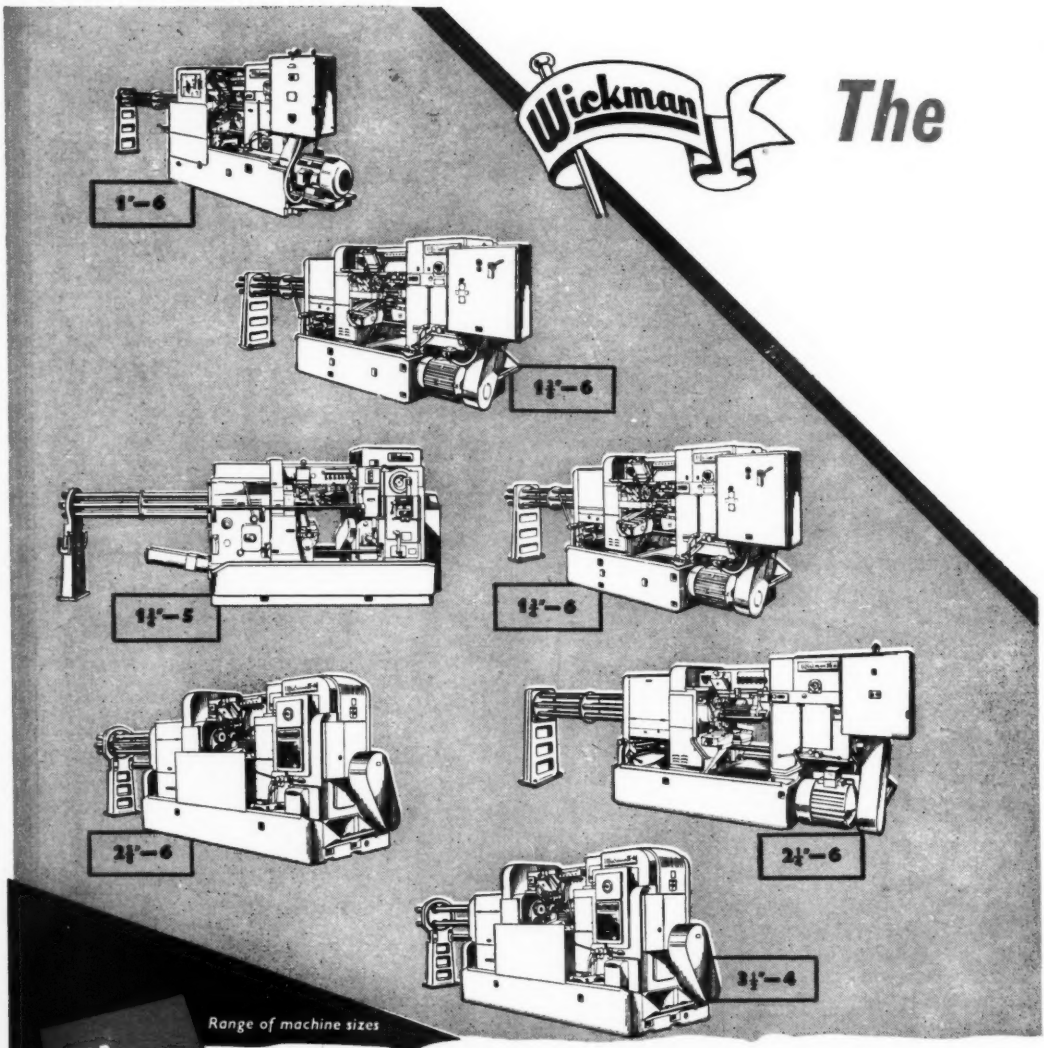

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	1—6	1¼—6	1½—6	1¾—5	2¼—6	2½—6	3¼—4
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Spindle speeds—r.p.m.	247-330	132-2,000	132-1,667	126-1,368	111-1,302	70-1,004	60-786

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... and of course — no cams to change!

Automatic choice

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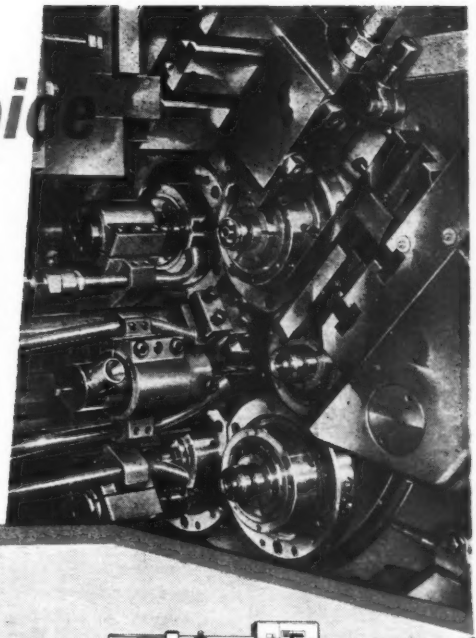

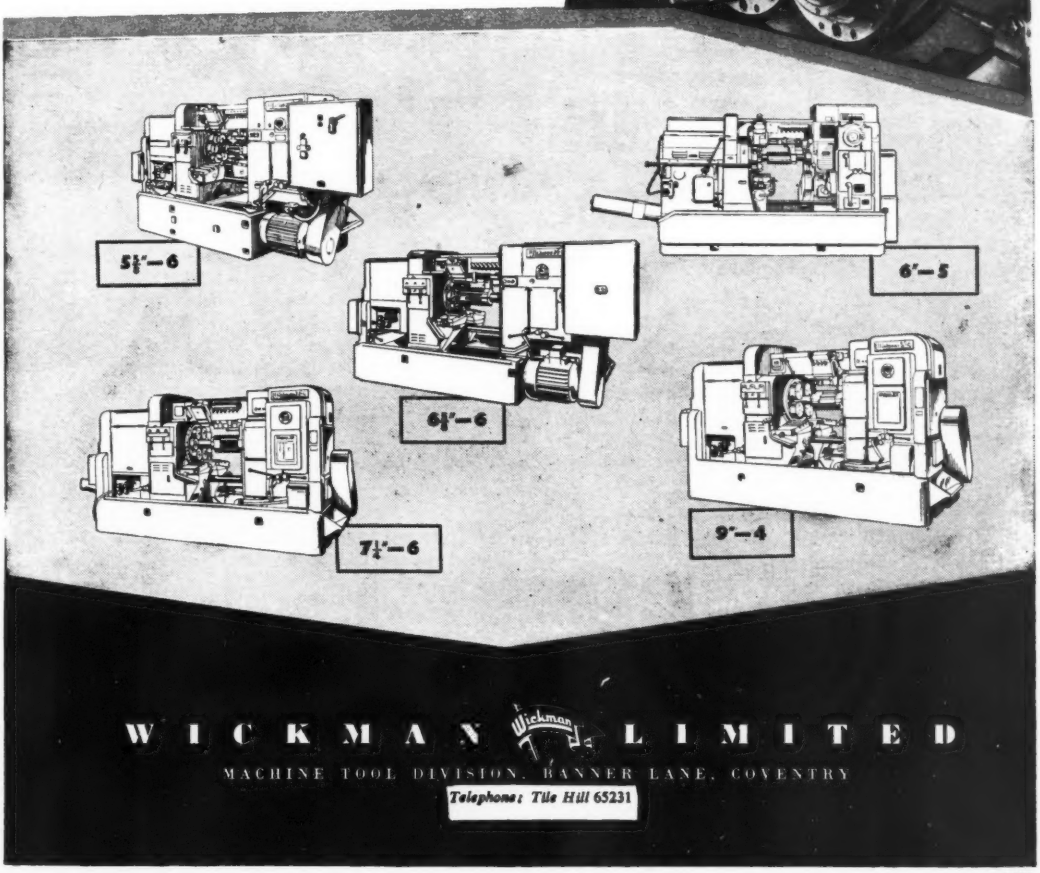

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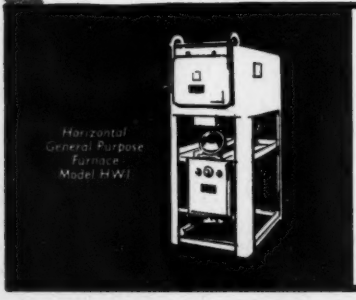
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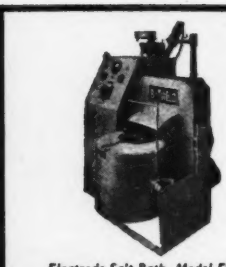
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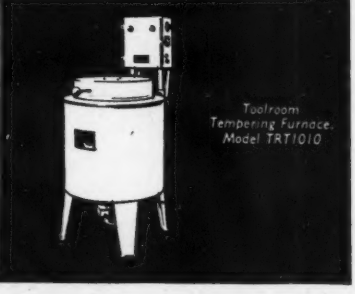
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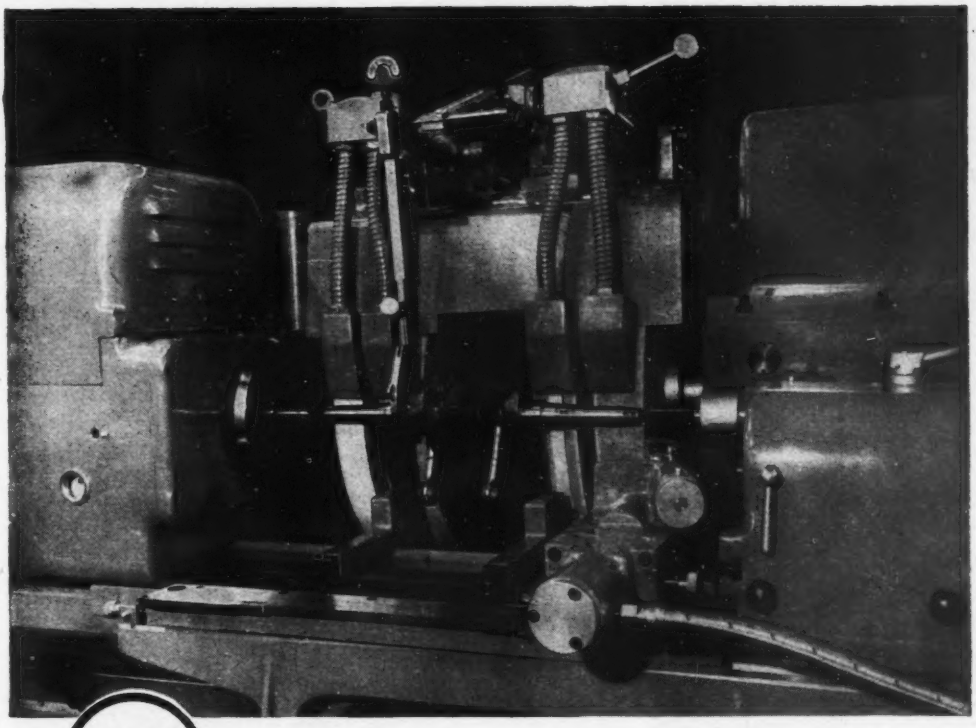

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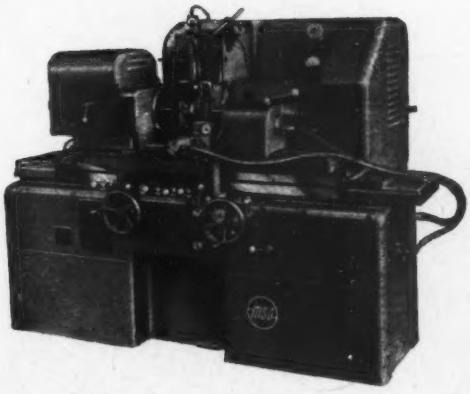

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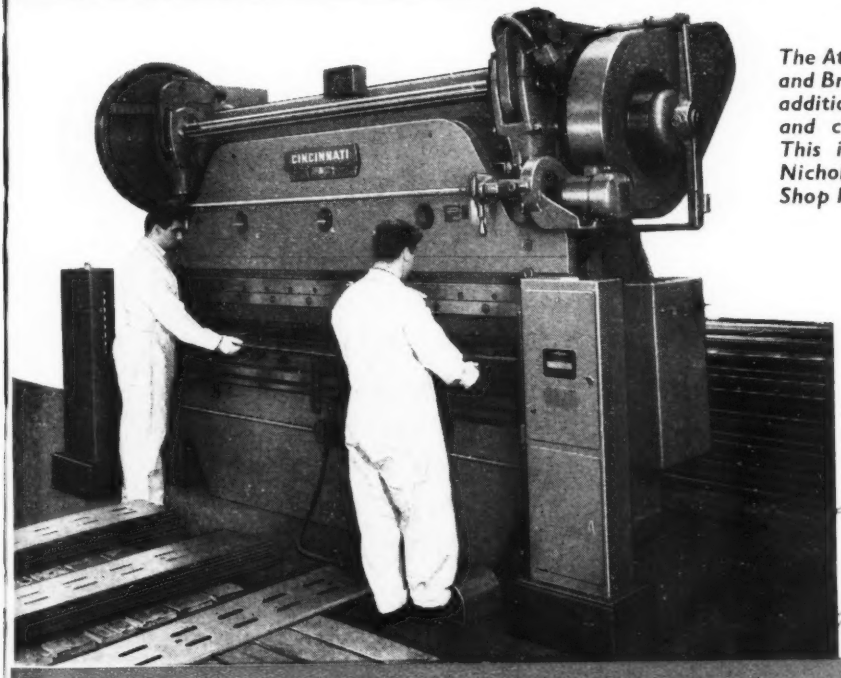

The Atlas Lighting Division of Smar and Brown (Engineers) Ltd. require additional Press Brake capacity and chose a Cincinnati machine. This is the comment of Mr. Nicholson, the division's machine Shop Foreman:-

" The Cincinnati Press Brake on which we decided has now been in operation for six months. It has been thoroughly proved, and we are very pleased with our choice. The accurate control of the ram together with its Press button adjustment, and the consistency maintained in forming our 8 feet long Atlas Lighting Components are outstanding points in the machine's general high performance."

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If you wish to increase your Press Brake capacity, or replace old machines— choose CINCINNATI.

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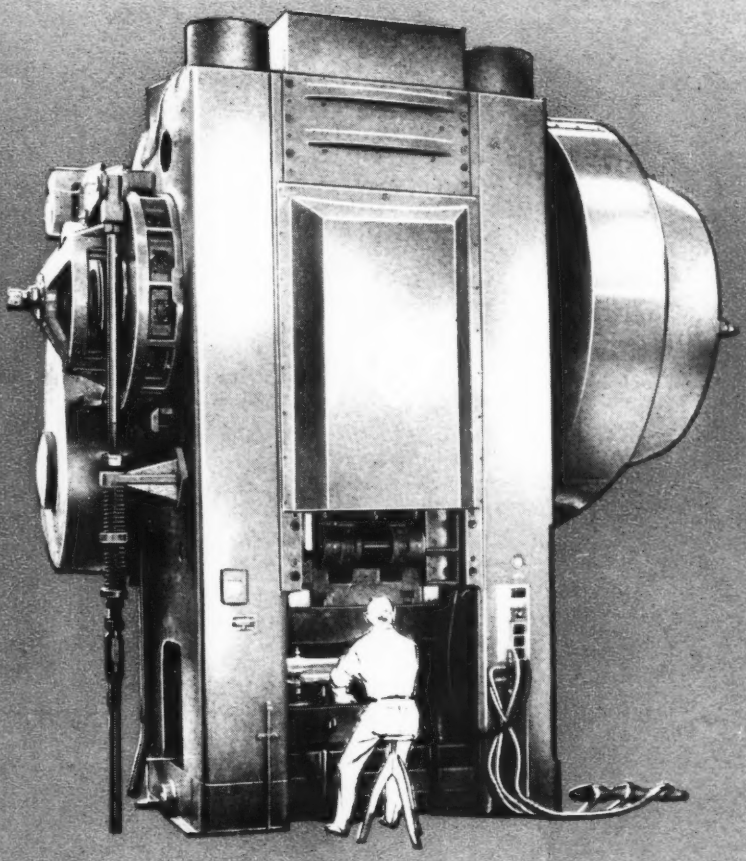

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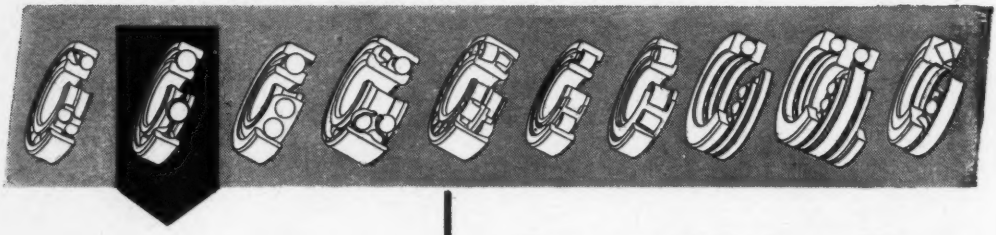
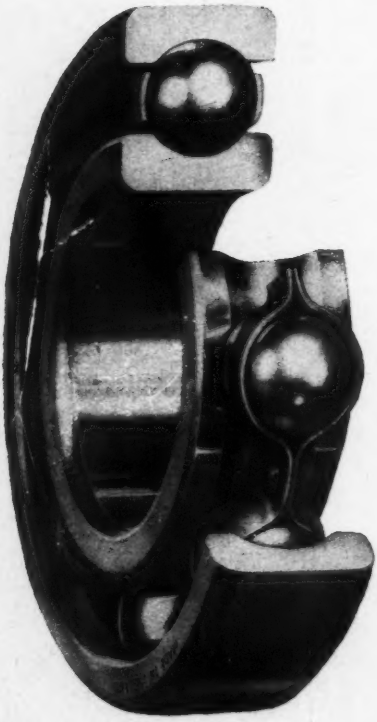
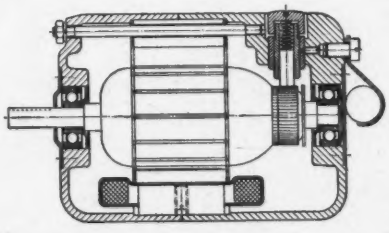




Illustrated here is the single row deep groove ball bearing, the most widely used of the ten variants of the four basic types of ball and roller bearing made by The Skefko Ball Bearing Co. Ltd.

The groove depth, ball size, and high degree of conformity between balls and tracks enables SKF single row deep groove ball bearings to deal with considerable thrust loads in addition to radial loads even at very high speeds.

A unique fund of technical information and experience lies behind the design of every SKF bearing—experience which is freely available to you whenever you have a bearing problem.



Bearing scheme for a small fan motor incorporating two single row deep groove ball bearings.

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The Production of Printed Circuits and Industrial Nameplates .. .. P. 592

Millett, Levens (Engravers), Ltd., and their subsidiary company, Printed Circuits, Ltd., both of whom are associated with the A.E.I. group, are specialist manufacturers of many types of industrial nameplates, printed circuits, and etched-foil components produced by printed-circuit techniques. The methods and equipment employed at their factory at Stirling Corner, Barnet By-pass, Boreham Wood, Herts., are common to both types of products, and include an automatic "step-and-repeat" camera for the preparation of multiple-image works negatives. In a well-equipped clean-conditions department, these negatives are used for reproducing the etch-resist patterns on circuit-boards, metal sheets or foil, or corresponding patterns on zinc plates used for offset litho printing. The latter process is used for large-quantity work, and provides a very high output capacity. Etched-foil products include a wide range of strain-gauges, in some 100 different combinations of size, design, material and thickness, and the methods used in the manufacture of these items are discussed. (MACHINERY, 99—13/9/61.)

Making Components for the Kopp Variable-speed Unit .. .. P. 616

The sole licensees for the sale and manufacture of the Swiss-designed Kopp variable-speed unit in this country are Allspeeds, Ltd., Accrington, and the company has recently taken possession of a factory of 110,000 sq. ft. This article describes the production of the main drive balls, of which the company makes approximately 50,000 per year, for units manufactured in the works, and for use by Kopp licensees in other parts of the world. Solid forged balls are first centreless ground on a modified Cincinnati machine, and are then drilled, reamed, and relieved in the bore on Ward 2C capstan lathes. A succession of grinding operations follows, and super-finishing to 1 to 2 micro-inches is carried out on vertical machines with opposed cast-iron laps. Inspection is on a 100 per cent basis, and selective grading is employed to ensure that all the balls in any Kopp unit are of the same diameter within 0·0001 in. (MACHINERY, 99—13/9/61.)

Diagnosis of 3-phase Motor Troubles P. 624

This article is concerned with the various symptoms which invariably appear prior to a fault occurring in a polyphase motor, and the means whereby these symptoms can be used to diagnose the probable cause of trouble, and in some instances to take preventative action. The topics discussed include: protective devices; short circuits and earth faults; faulty starting; starting torque; overloads; permissible temperatures, and causes of overheating. (MACHINERY, 99—13/9/61.)

Mechanism for Instantaneous Opposed Reciprocation of Parallel Shafts .. P. 630

The mechanism here described was developed for use on textile machinery, and replaces a cam-operated device that was subject to excessive wear. Drive is taken from a constantly-rotating, uni-directional shaft, and by means of constant-mesh gears, special rolling keys, and pinions, is transmitted to two parallel racks. The special keys are actuated by dead stops, which can be adjusted to provide for virtually instantaneous reversal of the two racks. (MACHINERY, 99—13/9/61.)

Seam-welding Stainless Steel .. P. 637

To fabricate air-tight containers from 0·003-in. thick AISI type 304 stainless-steel sheet at the Knoll Atomic Power Laboratory, U.S.A., it was necessary to weld several lap-seam joints. Suitable welding equipment was not available, and the small numbers of containers required did not justify new plant. The work was carried out on a Federal Tweezer Weld bench-type spot-welding machine, which was specially modified by the Laboratory to allow seam welding to be performed. Details are given of the modifications, and it is stated that the equipment was also used for seam-welding carbon steel, brass, and platinum, in thicknesses from 0·002 to 0·006 in. (MACHINERY, 99—13/9/61.)

Index to Exhibits at the 7th European Machine Tool Exhibition Described on pages 601—612 of this Issue

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Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

EDITORIAL

Developments in the Application of Ultrasonic Vibration

During the post-war years, ultrasonic vibration, which, we believe, was first employed in the metal working industries to remove oxide film from aluminium wires in preparation for soldering, has continued to find fresh applications and sometimes in directions that could hardly have been anticipated. Already processes based on such high frequency vibration are well established for a variety of purposes, among which may be mentioned the cleaning of precision components and assemblies to high standards by immersion in agitated fluid; the soldering of such metals as aluminium on which oxide films must be broken down; acceleration of certain pickling operations to avoid the need for prolonged soaking; detection of internal flaws in welded joints, also in forgings, castings and rolled products; thickness measurement of metals and other materials where only one side of the workpiece is readily accessible; machining operations on hard and brittle materials which may be either metallic or non-metallic; and certain welding operations which may present difficulties when other methods are employed. Recently, moreover, it has been reported that very promising results have been obtained by subjecting grinding wheels to an ultrasonic cleaning action while in operation to prevent the build up of metallic particles and maintain a free-cutting condition for long periods.

It also appears to have been established that definite advantages are to be gained from the application of ultrasonic energy in connection with electroplating processes. The resulting agitation of the solution, it is stated, counteracts the depletion of the diffusion layer of ions between electrode and electrolyte which may result from the formation of bubbles at the electrode faces. Consequently, anode polarization and cathode starvation can be virtually eliminated and plating speeds considerably increased. It is also possible, although conclusive evidence has not yet been forthcoming, that some abrasion of electrode surfaces is caused by cavitation, and that absorbed materials which might otherwise reduce the active surface area are thus removed. Irrespective of the reasons, however, it is reported that ultrasonic vibration has been employed successfully in baths for the electrodeposition of numerous metals. In some instances, good distribution and improved rates of deposition have been obtained with current densities considerably higher than are normally employed, and it has also been shown that coatings can be produced in purer form, and with higher tensile strengths and hardness values.

A considerable amount of work has been carried out to determine the effects of ultrasonic vibration of molten steel and other metals on the structures formed during solidification, but although some promising results have been obtained, it appears that various problems remain to be solved before this treatment can be widely applied. Thus, in one instance it was found that whereas grain growth was greatly reduced in the lower portion of a large ingot, the effects did not extend for a distance of more than about 16 to 18 in. from the point of vibration application. It appears, therefore, that it may be necessary to modify the customary proportions of ingots to enable uniformity of treatment to be achieved. With smaller masses, difficulties associated with the attenuation of vibration effects do not arise, and beneficial effects have been reported. For example, columnar grain growth is said to have been suppressed with consequent elimination of planes of weakness. Russian research workers, moreover, have stated that the grain refinement is particularly marked in steels with high nickel content, and that much greater reductions per rolling pass are possible with some treated alloy steels than could normally be attempted.

Hitherto, the practical applications of ultrasonics in industry have mainly involved the transmission of high frequency vibrations through liquids or solids, but it is well known that such vibrations can also be transmitted through air. Recently, increased interest has been shown in equipment designed to take advantage of this characteristic, which can be employed for a variety of purposes in much the same way as a light source and a photo-electric cell. An ultrasonic receiver and transmitter can be positioned as required and the presence or absence of an obstruction which interrupts the beam between them can be detected. This obstruction may be a solid or a liquid and opaque or transparent. A system may be arranged to operate with a direct or reflected beam path between the transmitter and receiver. It is also

(*Continued on page* 643)

The Production of Printed Circuits and Industrial Nameplates

Methods Employed by Millett, Levens (Engravers), Ltd., and Printed Circuits, Ltd.

By S. C. POULSEN, Associate Editor

FROM MODEST BEGINNINGS in 1946, when their premises comprised a single room, and their capital was approximately £200, Millett, Levens (Engravers), Ltd., Stirling Corner, Barnet By-pass, Boreham Wood, Herts., have advanced to a major position in their specialized field as large-scale manufacturers of printed circuits, and industrial nameplates of many types. The examples of their work, shown in the heading illustration, represent but a small proportion of their overall range, which is extremely diverse. This range includes strain-gauges and other precision items produced from foil by printed-circuit techniques, also metal and plastics labels, panels, dials, scales, and numerous forms of "marked" work, for which various processes, or combinations of processes, are employed. Among the latter may be mentioned offset litho printing, screen printing, chemical engraving (etching), machine engraving, anodizing, dyeing, plating, and enamelling. Facilities are also available at the factory, for press work, machine dividing, die-sinking, and general machining.

In view of the firm's specialized experience of printing and etching techniques, and the growing demands of the electronics industry, entry into the field of printed circuitry, and the formation of a subsidiary company (Printed Circuits, Ltd.) in 1954, were logical developments. The premises at Stirling Corner were acquired in 1955, and in 1958, both companies became members of the L.E.W. (London Electric Wire Co. & Smiths, Ltd.) group, which subsequently became associated with the A.E.I. group. As a result of this latter association, the companies are now in a position to participate in development work on advanced printed-circuit techniques, for example, for integral printed components, multi-way switches, transistors, and solid-state semi-conductor devices. (See also MACHINERY, 98/332—8/2/61.) It may be mentioned, in this connection, that equipment for the vacuum deposition of thin metallic films is to be installed shortly at the factory. As a further example of the development work undertaken, it may be mentioned that the company has successfully produced, experimentally, printed circuits on Perspex.

Although the number of employees is comparatively small (80), and despite the problems

associated with the diversity of products, continually varying in design and quantity, the overall output is large. In 1958, for example, when there were only 60 employees, the average annual production of nameplates was of the order of 100,000,000. This high level of productivity is maintained by efficient methods, which provide, wherever practical, for the use of automatic equipment designed to afford the necessary degree of flexibility. Much of this equipment is of the companies' own designs, or has been built to their specifications, and it has recently been augmented by the installation of fully-automatic plant, of high capacity, for etching and anodizing.

PROCEDURE

The procedure employed for producing printed circuits is basically the same as for etched or anodized nameplates. Initially, a master drawing is prepared, either by the company or the customer, to an enlarged scale that ranges from twice to 24 times the size of the final product, according to the degree of accuracy demanded. This master is then copied photographically, at a suitable reduction, on a process camera, to obtain a negative of the final size of the product, and the maximum negative area of the camera is 22½ in. by 18 in. Exposure is carried out by carbon-arc light, and the litho fine-line definition film employed is subsequently processed in a litho developer.

Where the degree of reduction to actual size is comparatively small, it is carried out at a single stage. If it is large, however, it is effected in stages, by preparing a series of successively-reduced negatives, to achieve maximum definition and accuracy. To ensure dimensional stability, the final negative is on polystyrene or glass, the latter being employed mainly for fine, close-tolerance, work such as strain-gauges. Where the dimensions of the image on the master negative are large enough to permit such a procedure—for example, for the majority of printed circuits and nameplates—any necessary retouching is carried out at this stage, with the negative placed over a light-box. Where the image is too fine for hand work, as is the case with some of the smaller strain-gauges, the necessary standard of image-quality must be obtained by the exercise of special care during the course of the photographic processing.

The subsequent procedure varies somewhat according to the size, quality, and batch-quantity of the work, and also depends, to a certain extent, upon the largest size of negative (6½ in. by 8½ in.) that can be accommodated on a "step and repeat" camera used for preparing works negatives, as will be described later. For large circuits or panels exceeding this size, and up to the maximum negative-area of the process camera earlier mentioned (22½ in. by 18 in.), works negatives are prepared singly by contact-printing them directly from the master negatives. If even larger works negatives are required, they are produced in the same way, and are joined together to build up the required size. This method enables individual or multiple circuits and panels to be produced on boards and sheets up to 25 sq. ft. in area, and is well suited to work in this category, since items of such size are seldom required in very large quantities.

A major proportion of the medium- and large-quantity work handled is within the 6½ in. by 8½ in.

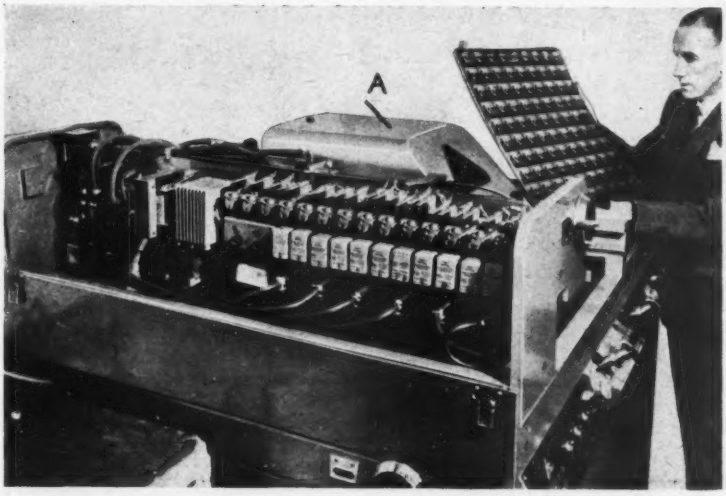


Fig. 1. The "step-and-repeat" camera, here shown, which is employed for preparing multiple-image works negatives, is fully automatic, and the image spacing can be preset within 0·0001 in., to reduce cumulative errors to a minimum

master negative capacity of the "step and repeat" camera already mentioned, and most of the works negatives are therefore prepared by this means. The "step and repeat" camera used is shown in Fig. 1, with the cover removed, to enable details of the electronic automatic control equipment to be observed. Access for loading the master negative into the horizontal holder is gained by raising the hinged cover *A*, and the holder supports the negative immediately above an air-operated traversing vacuum table, which will accommodate sheets of film up to 24 in. by 20 in.

When the automatic cycle is initiated, the table is indexed longitudinally to a series of predetermined positions, at each of which the master negative is held in close contact with the film, and exposed for a controlled period to the light from a special tungsten lamp. On completion of one row of exposures, the table is indexed transversely, and another row is made in the same way. When the whole area of the film has been covered, the camera stops in readiness for unloading. The camera can be left to run unattended, and when it stops at the end of the cycle, a buzzer outside the darkroom is sounded automatically.

In both directions, the indexing stroke of the table—and consequently the spacing of the repeat images—is steplessly variable from almost zero, to the corresponding maximum dimension of the master negative. Selection of the stroke is made by means of a separate dial-type control for each direction, and each control incorporates a vernier scale whereby it can be set within 0·0001 in. The ability to set to this degree of accuracy enables the effects of cumulative errors, over a large number of repeat images, to be virtually eliminated, and provides for maintaining correct register on work requiring two or more matched negatives. Examples of work in this category include double-sided circuits, circuits over-printed with component identification or other marks, and multiple-colour anodized nameplates. In each instance, a separate negative is necessary for each impression, coloured or otherwise, and for the anodized nameplates, up to four colours may be required.

PHOTO-MECHANICAL DEPARTMENT

After the works negatives have been developed, and retouched if necessary, they are passed to the photo-mechanical clean-conditions department, a general view of which is given in Fig. 2. This department is pressurized with filtered air of controlled temperature and humidity, and all persons entering it must do so through an air-lock, in which they change into special dust-free clothing. As a further precaution against the ingress of dust, "tacky" mats are provided in the entrances to the air-lock and the department, to remove dust and grit adhering to shoe-soles. Similarly, within the department, floor-sweeping is carried out with the aid of special tacky brooms.

Fig. 2. General view of the clean-conditions photo-mechanical department, where the circuit-boards, metal sheets, and zinc plates used for offset litho printing, are coated with light-sensitive emulsion, and contact-printed. Subsequently, soluble emulsion is washed away from the unexposed areas

The duties of the photo-mechanical department comprise (*a*) the preparation of zinc plates, by emulsion coating, exposure and development, for subsequent use on offset litho printing machines; (*b*) the coating of certain circuit-boards and work sheets with etch-resistant material, by generally similar methods; and (*c*) the production of small

Fig. 3. Emulsion coating is carried out with the work mounted on a revolving table, as here shown. The speed of the table is variable, to permit control of the coating thickness

precision items, such as the strain-gauges already mentioned, by methods that will be described later in this article.

Where the quantities involved are too small to warrant the preparation of zinc plates, or the work is too large to be accommodated on the printing machines, the emulsion is applied directly to the work sheet or board. For larger quantities, however, the zinc plates are used for printing with an etch-resistant ink on circuit-boards, and sheets for chemically engraved or anodized nameplates. The zinc plates are also used for printing nameplates directly, with various coloured inks.

Emulsion coating is facilitated by the use of power-driven turntables, known as "whirlers," a representative example of which is shown in use in Fig. 3. Provision is made for varying the speed, for controlling the thickness of the coating. Before the work is placed on the turntable, the surface is chemically cleaned. Then, with the work revolving fairly slowly, the emulsion is poured on to the centre, as shown. Once the surface has been evenly flooded with emulsion, the speed is increased to give the required thickness of coating, and the cover is lowered. The duct incorporated in the cover houses an electric heater and a fan, which blows a stream of warm air on to the surface of the revolving work, and after about 5 min. the machine is stopped, and the work unloaded. Since the emulsion is relatively insensitive to ordinary natural or artificial room lighting, no special precautions, other than the avoidance of direct sunlight, are necessary.

The 15-amp. arc lamps employed for exposing the coated plates, sheets and circuit-boards are housed in compartments in the base of the main exhaust duct of the air conditioning system. This duct, which is situated in the centre of the shop, may be seen in Fig. 2, and installation of the arc lamps in this manner ensures that heat, and any dust from the carbon rods, are carried away in the exhaust air. A view of one of these stations, showing the arrangement of the lamp, and the design of the printing frame, is given in Fig. 4. The frame comprises a metal tray, mounted on trunnions, which is provided with a hinged glass cover, seen raised, and within the tray, there is a loose rubber lining. This lining has thickened edges, that serve as seals when the cover is closed.

Fig. 4. Typical vacuum contact-printing frame, in course of loading. When the interior of a rubber lining is exhausted, work and negative are held in contact with the glass cover by atmospheric pressure. The light-source is a carbon arc lamp

Fig. 5. The large " whirler " here shown enables sheets and circuit-boards up to 25 sq. ft. in area to be coated with sensitizing emulsion. The table speed can be varied, up to a maximum of 200 r.p.m.

The emulsion-coated zinc plate, work sheet, or circuit-board is placed in the tray, followed by the negative, the edges of which are masked with black paper. When the glass cover has been closed, the space between the rubber and the glass is exhausted through a vacuum line, by turning the tap *A*. The work and negative are then held closely against the glass, by atmospheric pressure on the outer surface of the rubber. Next, the frame is swung into a vertical position, and the arc lamp is switched on for the required exposure period.

After exposure, the zinc plates are coated with a special ink, and swabbed over to leave a thin even layer, which is then " developed " by washing in running water. The insoluble exposed portions of the emulsion, together with the ink coating, remain attached to the plate, but the ink and emulsion are washed away from the unexposed areas. Following this stage, the work is dried by replacing it in one of the whirlers, after which it is coated with protective gum, and is then ready for use on the printing machines. The procedure for small-quantity or special etched work, including circuits and nameplates, for which the preparation of zinc plates is not justified, is generally similar, except that the final gum-coating stage is omitted. In this instance, the presence of the ink on the exposed insoluble areas of the emulsion serves to increase the etch-resistance.

The equipment of the photo-mechanical department includes the larger whirler shown in Fig. 5. This machine, which is used mainly for large circuit-boards up to 5 ft. square, provides speeds up to 200 r.p.m., and because of the large diameter of the table, the emulsion is poured on to the centre of the work from a can with a spout. As on the other machines in the department, a fan and heater are installed in a duct in the cover, for drying the work rapidly. All controls, including selector switches for table speed and fan heater temperature, are seen mounted at the right. In an adjoining section of the department, there is a correspondingly large vacuum printing frame, which is generally similar in design to those already described. This equipment is served by a 3-phase 60-amp. arc lamp.

OFF-SET LITHO PRINTING

As already indicated, for the bulk of the firm's work, the application of etch-resistant media to circuit-boards, and to sheets for chemically engraved and anodized nameplates, is carried out on offset litho printing machines. A set-up for direct colour-printing of metal labels, is shown in Fig. 6. The zinc plate *B*, and the work sheet or circuit-board *C*, are mounted on flat platens, on which they are located and held by the edges. A set of inking rollers (not visible) and a rubber-covered offset roller *D*, are carried on the head *E*, which is arranged to traverse along the bed. At each end of the offset roller, there is a pinion *F*, which meshes with a rack *G*, mounted on the bed. These pinions are of such a diameter that when the head is traversed, the offset roller is rotated exactly at rolling speed, without slip in relation to the platens.

During the return stroke of the head, at the end of which it stops in the position seen in Fig. 6, the offset roller is raised slightly, to clear the work and the zinc plate. Meanwhile, one of the inking rollers, as it passes over the zinc plate, applies ink or etch-resisting medium to the raised

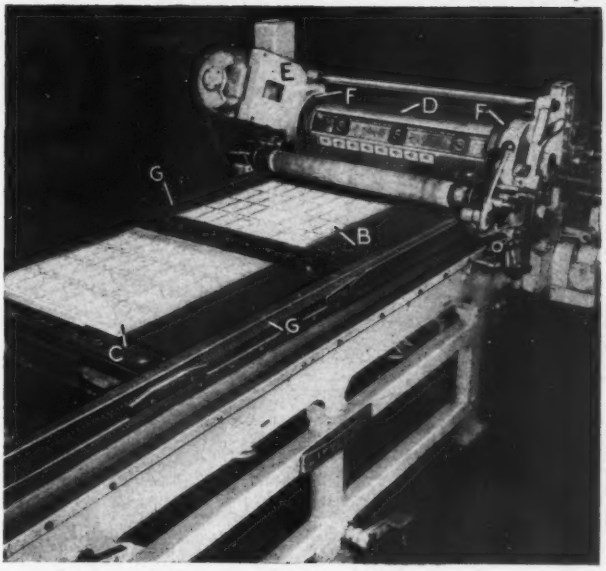


Fig. 6. One of several offset litho printing machines, which are used for printing etch-resisting media on to circuit-boards and metal sheets, as well as for direct printing with coloured inks

surfaces formed by the emulsion pattern. At the next forward stroke, the offset roller is lowered to the working position, and as it travels over the zinc plate, completing one revolution, the inked pattern is transferred to the surface of the rubber. With continued travel, the offset roller completes a further revolution as it passes over the work, to which the pattern is transferred, and the head then returns to the initial position, in readiness for the next cycle. The machine will accommodate work up to 24 in. by 18 in., and since a board or sheet carrying the multiple impressions is unloaded after every forward and return stroke, the output capacity, in terms of individual circuits or nameplates, is very high.

On work that is subsequently to be etched, the etch-resistance of the printed pattern is increased by dusting it with bitumen powder, followed by a baking process that fuses the bitumen into a continuous, impervious layer. To ensure adhesion of the powder, this treatment is carried out as soon as possible after printing, while the ink is still tacky. Dusting and baking are carried out on a continuous basis, with the conveyorized plant shown in Fig. 7, in which this equipment is viewed from the output end. At the input end, there is a special-purpose machine, of the firm's design.

The housing of this machine incorporates two compartments, in the first of which there is a hopper containing the bitumen powder, and a pair of goat's-hair roller-type rotary brushes. These brushes distribute the powder evenly over

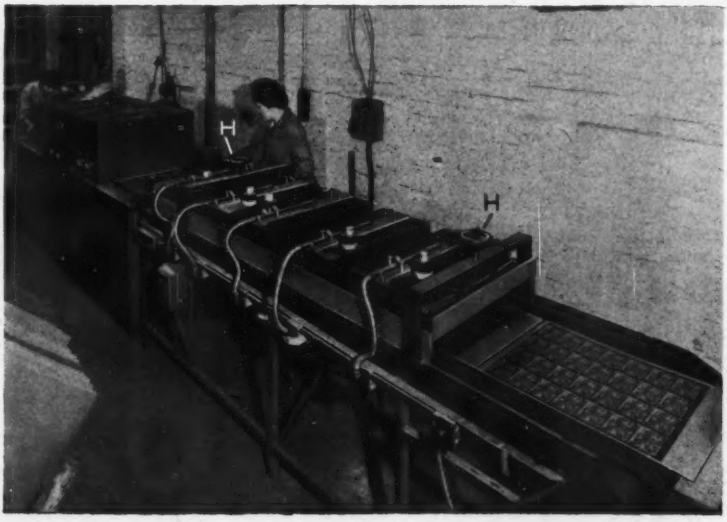


Fig. 7. The conveyorized special-purpose equipment here shown provides for coating the printed work with bitumen powder, and subsequently baking it by infra-red heating, to increase the resistance of the ink chemical during etching

the work as it is carried beneath the hopper, and remove loose excess powder, so that only the inked portions are coated. The arrangement of the second compartment is generally similar, and here the work is coated with French chalk. At both stations, controls are provided for adjusting the height of the brushes, and the rate of powder delivery from the hoppers.

As the powdered work is delivered from the machine, it is checked visually by the second operator, who transfers it to the chain-mesh conveyor of the heating section. This section comprises an adapted Vokes varnish-drying machine, supplied to the firm's specification. It incorporates five 2·5 kW. heads, each of which is provided with three rod-type infra-red heating elements and a reflector. These units are mounted on a frame that can be raised, lowered, or tilted in either direction, by means of the handwheels *H*, and a switch is provided on each head for turning on or off, one, two or three heating elements. In addition, the speed of the conveyor is adjustable. These various adjustments afford a wide range of control, which is particularly necessary since the rate at which the work is heated depends on the ink metal area-ratio. Moreover, on circuit-boards, excessive heating can cause blistering, whereas if the coating is insufficiently heated, the etch-resistance is impaired. Once the sheets or boards have been baked in this manner, they are ready for etching.

PRODUCING STRAIN-GAUGES

As indicated earlier, strain-gauges and other small precision components are produced from foil by techniques that are basically similar to those employed for printed circuits. Some reference to these techniques has already been made in MACHINERY (90/937—26/4/60) and they are here considered in greater detail. The strain-gauges, which are marketed in association with Saunders-Roe, Ltd., are made in some 100 different combinations of size, design, material, and thickness, the most commonly-used materials being cupro-nickel and nickel chromium alloys. Some representative examples are shown in Fig. 8. The chevron design, seen at the top, is for torsion tests on tubular components, and the approximately circular types in the third row provide for other forms of torsion-testing. At the extreme right is seen a special type of gauge used for testing permanent-way rails.

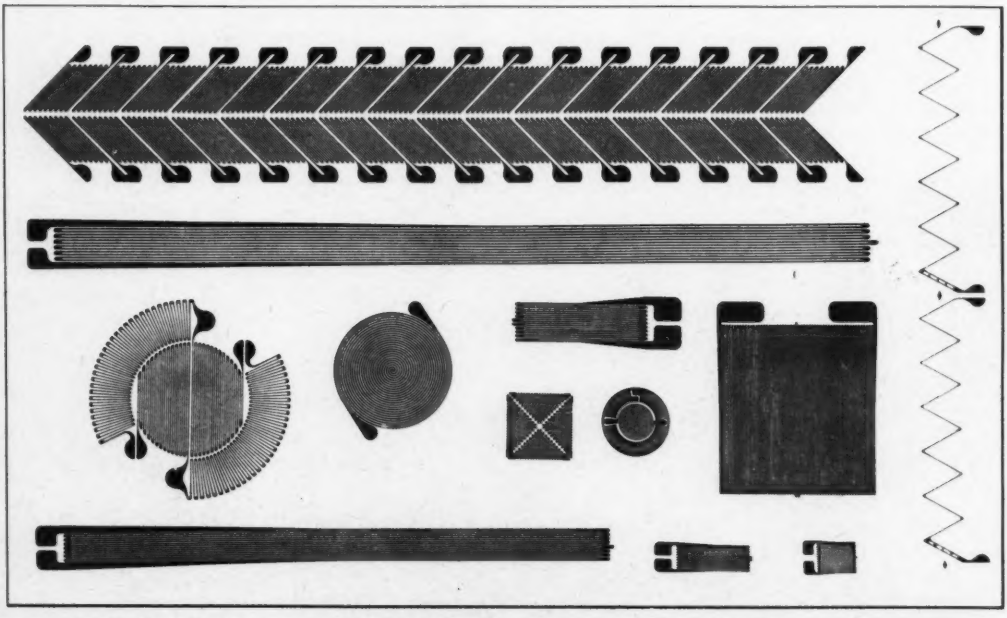


Fig. 8. Typical strain-gauges produced by foil-etching and circuit-printing techniques. The foils employed range from 0·001 in. to 0·0002 in., and there are some 100 different combinations of design, size, material, and thickness

Gauges of the "standard" rectangular design, several of which are also illustrated, are made in a wide variety of sizes. The smallest at present produced has an area of ⅛ in. by 0·081 in., and comprises 14 lines, 0·003 in. wide, with equal spaces of the same width between them. This example is of 0·0002-in. cupro-nickel foil, on a 0·0005-in. backing film of epoxy resin. Typically, the tolerances on the electrical resistance of the strain-gauges are of the order of ±5 per cent. Since this characteristic is related to the cross-sectional area of the lines, process control during manufacture must be related to the thickness-tolerance of the foil. One method of compensation for variations within this range entails the use of master drawings and/or negatives, in which the line-widths are correspondingly wider or narrower than nominal. The foil manufacturers have recently introduced a system of continuous gauging, whereby a graph showing the thickness variation can be supplied with each coil, and process control, during the production of the strain-gauges, is thus facilitated.

Fig. 9. Visual inspection of the strain-gauges is facilitated by direct optical projection, at a magnification of 40×, as here shown. A high standard of accuracy is essential, since line-widths of the order of 0·003 in. are often involved

In the photo-mechanical department, the sheets of foil, previously cut to a convenient size, are taped to light steel frames, to hold them flat during the application of the backing material by spraying. The backing varies according to the nature of the work, and in addition to the epoxy resin already mentioned, includes strippable and soluble types. Epoxy resin is used if a permanent support is required, whereas the other types are employed if the etched foil is subsequently to be removed from the backing, or transferred to another form of support. On strain-gauges, the thickness of the epoxy resin film must not be excessive in relation to that of the foil, and for 0·0002 in. foil, the 0·0005-in. film thickness, mentioned above, is typical. The thickest foil used for strain-gauges is 0·001 in., and for such foil, the film thickness is 0·002 in. Film thickness is determined by the number of coats applied and is checked by measurement of the combined thickness of foil and film.

The paint spraying shop, in which the backing is applied to the foil, is fully equipped for handling all types of paint or lacquer, including Birlon strippable protective film, painting etched nameplates prior to the removal of the resist, flux lacquering etched circuit-boards, stoving, and all similar processes associated with the firm's products. Facilities available include an overhead conveyor, on which the work is sprayed, and a gas-fired infra-red stoving oven. This oven is also used for heat curing the sprayed backing applied to the foil.

When the backing has been cured, the work is returned to the photo-mechanical department, where the metal face is thoroughly cleaned, in readiness for emulsion coating. For this purpose, it is scoured, washed and rinsed, followed by coating on a whirler, contact-printing, and development, as already described. Drying, after development, is accelerated by rinsing in a mixture of alcohol and water, and the work is retouched if necessary. Etching, with ferric chloride, is carried out with the work suspended in a stoneware vat, in the centre of which there is a power-driven Archimedean spiral impeller. This impeller raises the etchant from the bottom of the vat, and delivers it on to the work in the form of a spray.

On removal of the work from the etching vat, it is washed in clean water, followed by rinsing in dilute citric acid solution, and it is then scoured again, finally washed, and hung up to dry overnight. When dry, it is placed between sheets of cardboard, in which it is transferred to the inspection department. Here, the combined thick-

ness and the film thickness are again measured, to ascertain the final thickness of the foil. The work is also checked visually for general quality, line continuity, and "bridging" between lines, and a reference number is marked on the backing film, against each gauge, with the aid of a ball pen. These numbers serve to identify the gauges when they are later placed in an optical projector, and examined at a magnification of 40×, as shown in Fig. 9. All sound gauges, selected during the foregoing checks, are finally tested for electrical resistance, on an instrument of the electronic bridge type, and facilities are also available for oscilloscope tests.

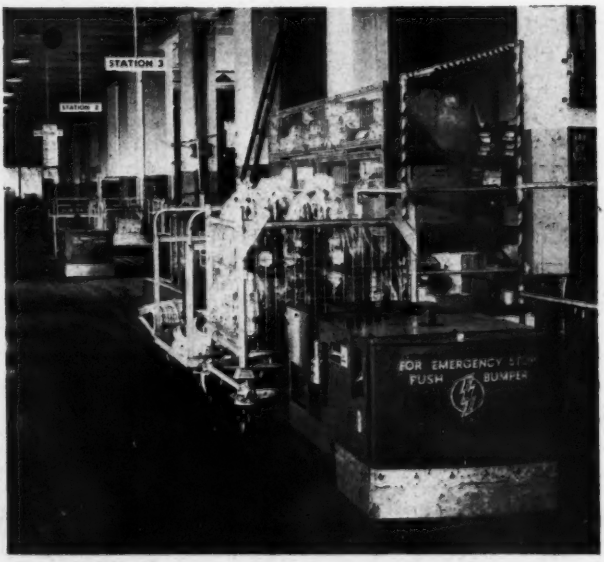
Some further interesting examples of the firm's methods, and the automatic etching plant earlier mentioned, will be discussed in a later article to be published in MACHINERY.

Use of Robotug Driverless Tractors at the Warehouse of Rootes Motors (Parts), Ltd.

The main warehouse at Small Heath, Birmingham, of Rootes Motors (Parts), Ltd., is now equipped with an extensive track layout and two Robotug driverless tractors supplied and installed by E.M.I. Electronics, Ltd., Hayes, Middlesex. As described in MACHINERY, 96/224—27/1/60, the guidance system causes the Robotug to follow a single wire buried below the surface of the floor. It is intended later to extend the system to three other stores buildings.

Previously, all material was moved by electric pallet trucks, controlled by human operators, who were not always available when required, and the flow was irregular. The Robotugs are used in the "goods inwards" department, for handling material received by road vehicles from Rootes factories in special crates, and from other suppliers either loose, in crates, or on pallets. Material received from Rootes factories is transferred to waiting trailers for towing by Robotugs to lifts, which take them to stores areas on upper floors.

Goods received from other sources are loaded on to trailers which are towed by Robotugs to checking areas, as seen in the accompanying illustration, and after being checked, they are transferred by means of the Robotugs to the lifts, for storing in the areas on the upper floors.



A view showing four of the goods checking stations served by the Robotug driverless tractor system in the main warehouse at Small Heath, Birmingham, of Rootes Motors (Parts), Ltd.

On the return journey to the receiving area, the Robotugs take back empty trailers. An alternative bypass route is sometimes used for transporting materials which do not require checking, directly to the lifts for delivery to the storage areas. This alternative route is also used when it is necessary for several empty trailers to be cleared quickly from the lifts.

A feature of the system is the use of four automatically rising doors which are actuated by the approaching Robotugs as they pass certain points on the track. The layout is such that the track starts inside the building, goes out and comes back inside, goes out again to a covered way, and then returns to the building. The purpose of the automatic doors is to exclude draughts and cold air from the main working area of the warehouse as far as possible.

7th European Machine Tool Exhibition-Brussels THIRD ARTICLE

HEYLIGENSTAEDT HEAVY-DUTY AND COPYING LATHES

Built by the German firm of Heyligenstaedt (Bishop, Eaves & Sons, Ltd., 868 Alum Rock Road, Birmingham, 8), the type 800 Ebn heavy-duty centre lathe shown in Fig. 1 will swing diameters up to 62½ in. over the bed-ways, and can be supplied with various bed lengths to give capacities between centres from 3 ft. 4 in. up to 32 ft. 10 in. When a detachable bed piece is provided, work up to 78 in. diameter by 19½ in. wide can be swung in the gap. The normal 39½-in. wide bed has separate vee and flat guideways for the saddle and tailstock, but a 48¾-in. wide bed can be supplied, which has central and outer guideways.

Spindle drive may be taken from a motor of 40 or 75 h.p., through a flat belt to the headstock, and thence by a helical pinion to a faceplate gear. Twenty-four spindle speeds from 1·12 to 224 r.p.m. are available, selection being made by capstan-type handwheels on the headstock. There are separate sets of push-buttons on the headstock and saddle for controlling the driving motor, and dial-type instruments are built into the headstock for indicating the spindle speed and motor load. Bored $3\frac{15}{16}$ in. diameter, the spindle runs in roller bearings, and end thrust is taken on ball bearings.

The quick-change feed gearbox enables 79 metric threads from 1 to 896 mm. pitch, 80 Whitworth threads from 28 to $\frac{1}{32}$ per in., 69 threads from 0·25 to 224 module, and 80 threads from 112 to ⅛ d.p., to be cut. It also provides 80 sliding and surfacing feeds, the former ranging from 0·008 to 7·87, and the latter from 0·004 to 3·94 in. per rev. Rotation of a knob on the headstock enables 16 additional feeds from 0·002 to 0·031 in. per rev. for turning, and from 0·001 to 0·016 in. per rev. for surfacing, also a number of fine thread pitches to be obtained. Power feeds can be imparted to the swivel compound slide mounted on the cross-slide, for turning short tapers and cutting screw threads. For turning long tapers, the compound slide is set at an angle to the work axis, and is traversed under power feed simultaneously with the saddle. Rapid power traverse for the saddle at the rate of 140 in. per min., also for the cross-slide and the compound slide, is provided by a separate motor mounted on the apron. A Selsyn-controlled worm and rack drive can be provided in place of a feed shaft and leadscrew, for turning and screwcutting on lathes of length capacity exceeding 25 ft.

The substantial tailstock is adjusted on the bed-ways by worm gearing, and, if required, a separate

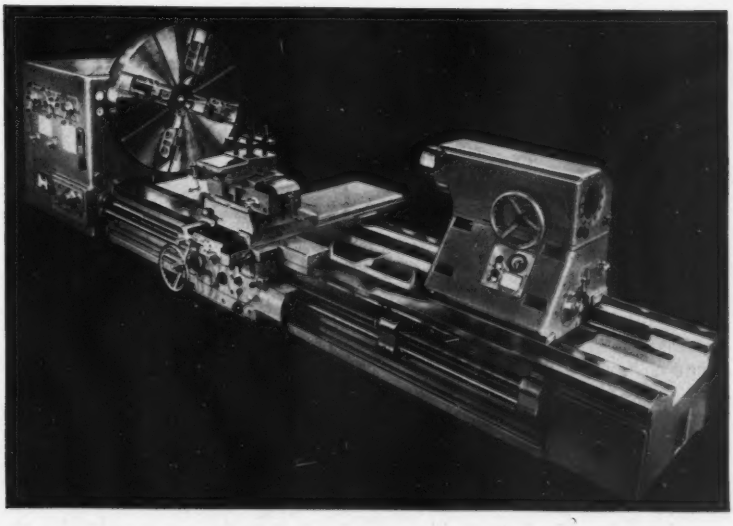


Fig. 1. Heyligenstaedt type 800 Ebn heavy-duty centre lathe

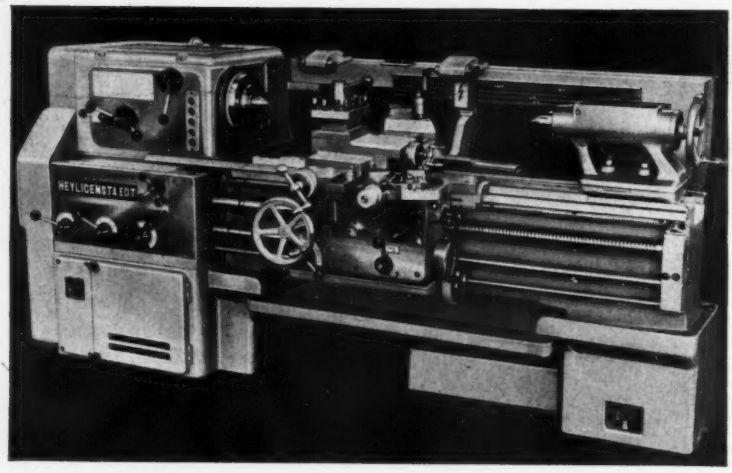


Fig. 2. Heycop type 1U universal copying lathe

motor can be fitted to give rapid power traverse at the rate of 175 in. per min. It can be supplied with a 6¼-in. diameter barrel, which will take a non-rotating centre, and can be adjusted for a maximum distance of 13⅜ in. by hand. Alternatively, a 9¾-in. diameter barrel can be provided, which has a built-in rotating centre and a motorized adjustment of 7⅜ in. End thrust applied to the centre is then shown on a dial-type indicator built into the base.

Hydraulic and electric copying equipment is available, and with the latter, the cutting tool is normally mounted in a 4-way toolpost on the top slide, and drive for the sliding and surfacing feeds is taken through gearboxes with built-in electromagnetic clutches at the end of the bed and the rear of the cross-slide.

Diameters up to 20⅝ in. can be swung over the bed-ways and 10⅛ in. over the copying slide on the Heycop type 1U copying lathe shown in Fig. 2, and the maximum length that can be accommodated between the centres is 80 in. Mounted on the saddle at an angle of 60 deg., the hydraulic copying slide enables profiles with a maximum depth of 5 in. to be turned, and carries a front cross-slide, top slide and 4-way toolpost assembly which can be adjusted in a direction at right-angles to the work axis. At the front of the saddle there is a knob fitted with a number of dogs which can be pre-set for controlling the depths of cut for several rough turning passes on the work. When the last roughing pass has been completed, a finishing cut is taken on the work entirely under template control. Profile shapes can be reproduced on the work from a template secured to the carrier at the rear of the bed, or from a master held between centres.

The copying equipment can be disengaged by operation of a lever on the apron, and the lathe can then be employed for conventional turning and screwcutting. Drive to the headstock is taken from a 7½-h.p. motor, and 18 spindle speeds are provided, which may range from 22·4 to 1,120 or from 28 to 1,400 r.p.m. The quick-change feed gearbox allows 60 screw threads from 1 to 224 mm. pitch and from 28 to ⅛ per in., also module and d.p. threads to be cut, and gives 60 sliding feeds from 0·0025 to 0·16 in. per rev.

When production copy turning only is to be carried out, the lathe can be supplied without facilities for screwcutting. A shaft is then mounted at the front of the bed which carries a number of adjustable dogs. When a stop on the saddle makes contact with one of these dogs, the shaft is turned to energize a double electro-magnetic clutch in the gearbox for reducing the sliding feed in the ratio of 2 to 1, as may be required for copy turning certain portions of the work. At the end of the copying stroke, the shaft is moved lengthwise by contact between the saddle and a fixed stop, to start a separate motor for rapidly returning the saddle towards the tailstock end of the bed. A tailstock with a motor-driven barrel can be supplied, also a holder for a boring bar, which can be mounted on the saddle, and brought into use simultaneously with the copying slide.

+GF+ DOUBLE-ENDED FACING AND CENTRING MACHINE

The fully-automatic facing and centring machine shown in Fig. 3, has been developed by Georg Fischer A.G., Schaffhausen, Switzerland (Vaughan Associates, Ltd., 4 Queen Street, Curzon Street, London, W.1), in collaboration with the German firm of Ernst Grob. Workpiece blanks are carried towards and away from the facing and centring

position by an indexing-type chain conveyor, which may be arranged to deliver them to a +GF+ copy turning lathe or some other machine in an automatic production line, if required. The cycle time for facing and centring may be set to correspond with that of the machine to which the conveyor is connected, and such an arrangement ensures that a continuous supply of blanks for machining is maintained.

This facing and centring machine is made in three sizes, designated type ZM-56, type ZM-80, and type ZM-112, which will handle bars from 0·6 to 6·3 in. diameter with lengths from 6 to 22, 16 to 32, and 28 to 44 in. The combined facing and centring heads can be set independently on guideways on top of the bed to suit the length of the blanks to be handled, and each unit carries a work-clamping arrangement which can be adjusted towards and away from the spindle nose for a maximum distance of 4·3 in. Each spindle is fitted with a collet to take a centre drill, also a detachable holder for two clamped-type tungsten carbide cutter blades for facing the end of the work. Drive is taken from a 2-speed motor, through a lever-operated gearbox, and the 4 spindle speeds obtainable range from 700 to 2,000 r.p.m. The cutter spindles have a maximum travel of 4·73 in., and steplessly-variable feeds from 0 to 100 in. per min. are provided hydraulically.

When a blank has been moved to the facing and centring position, it is gripped and raised clear of the conveyor by the clamping units, and the cutter spindles are then rapidly traversed to bring the centre drills close to the ends of the piece. The pre-set feed for centre drilling is then applied to the spindles. Just before the centres engage with the ends of the blank, the feed is automatically reduced to the value selected for facing, and at the end of the complete working stroke, which is controlled, positively, by a stop, the spindles are rapidly returned to their starting positions. After the work-holding jaws have been opened, the completed blank is lowered on to the conveyor, which is then indexed to move the piece clear and bring the next blank to the facing and centring position.

The conveyor normally extends for a length of 6½ ft. on each side of the machine, and the two pairs of roller chains are fitted with carrier plates for the blanks, and are driven by worm gearing from a single motor. The chains in each pair can be adjusted lengthwise in relation to each other for varying the distance between the carrier plates to suit workpieces of different diameters within the range that can be handled on the machine. In addition, the sprockets over which the chains pass can be adjusted towards and away from each other for handling blanks of different lengths.

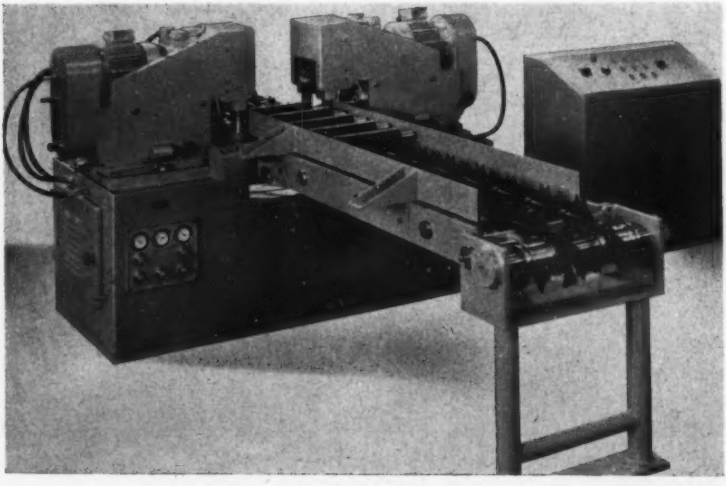


Fig. 3. +GF+ automatic double-ended facing and centring machine

BOEHRINGER TYPE Z 400 GEAR DE-BURRING MACHINE

The type Z 400 gear de-burring machine shown in Fig. 4 is built by Gebr. Boehringer, G.m.b.H., Goppingen/Wurtt., West Germany (Sykes Machine Tool Co., Ltd., The Hythe, Staines, Middlesex). This machine operates on a self-generating principle, and both helical and spur gears up to 15¾ in. diameter can be handled. The grinding wheel is formed with a worm profile on the periphery, which corresponds to the tooth form and pitch of the gear, the number of teeth in the latter being immaterial.

During de-burring, the teeth of the gear are in mesh with the worm profile on the grinding wheel, and the angle of contact results in a slight chamfer being produced on the tooth and space edges. The time required for the opera-

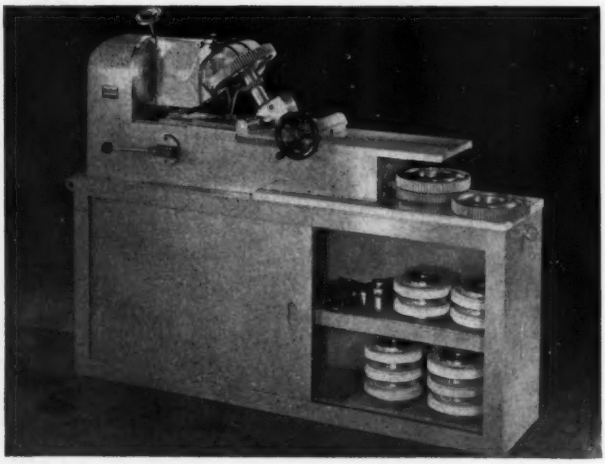


Fig. 4. Boehringer type Z 400 gear de-burring machine

tion is stated to be only about one-tenth of that needed for de-burring by hand, and the machine can be set up in from 1 to 5 min., depending on whether the wheel must be changed, or whether adjustment of diameter and height settings will suffice. A grinding wheel can be profiled in about 20 min., on a standard screwcutting lathe, the wheel being mounted on a mandrel between centres, and the thread form produced with a tungsten-carbide tipped tool.

Certain types of gear on which only a light action is required can often be de-burred by means of a wire brush in place of a grinding wheel. As the brush has no worm profile, it is engaged with the component at an angle to provide the drive, and the grinding head can be swivelled for this purpose.

PONTIGGIA LATHES

Built by Construzioni Macchine Utensili Leopoldo Pontiggia, Varese, Italy, the BS 500 sliding bed lathe shown in Fig. 5 is an intermediate size from a range. It has a centre height of 19¾ in. and will swing diameters up to 65 in. in the gap. The latter is 43¼ in. long when the bed is fully withdrawn, and workpieces up to 118 in. long and weighing up to 10 tons can be held between centres.

A total of 18 speeds from 4·2 to 400 r.p.m. is obtainable for the spindle, which runs in double-row roller bearings, and the drive is taken from a motor of 40 h.p. by way of hydraulically-operated clutches. A hydraulic brake is also provided, and this unit, and the clutches, are controlled by solenoid-actuated valves. There is a wide choice of feed rates, also of B.S.W., metric, module, and diametral thread pitches, and drive is taken to the apron of the saddle on the sliding bed by way of a shaft and a pick-up box.

On the type BS 500 lathe, power feeds are also obtainable for a second saddle unit, which is mounted on ways on a bed casting secured to the rear of the main base, and an additional lead-screw can be provided, for this unit, if required,

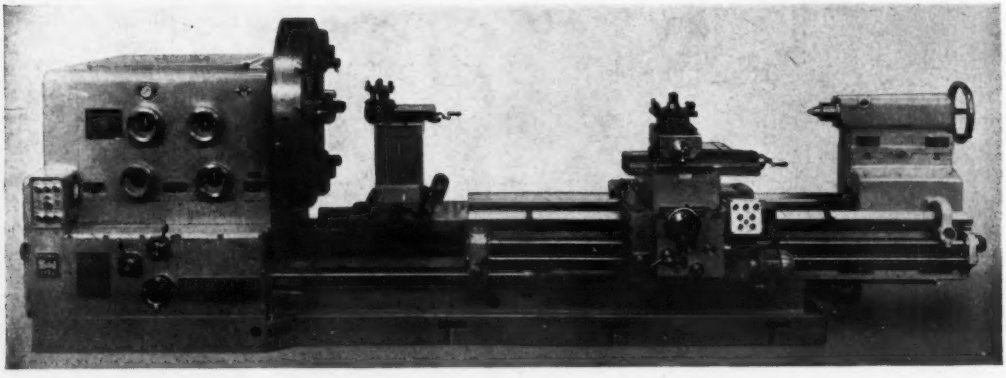


Fig. 5. Diameters up to 65 in. can be swung in the gap on this Pontiggia BS 500 sliding bed lathe, which is equipped with two saddles

to enable screw-cutting to be performed close to the headstock when the sliding bed is withdrawn. This rear saddle unit can be equipped with a cross-slide of special design to enable facing cuts to be taken on workpieces up to the maximum diameter that can be swung in the gap. Controls are provided on both saddles, also on the headstock, for engaging and disengaging the spindle drive, and, if required, electro-mechanical copying equipment can be incorporated in the saddle on the sliding bed.

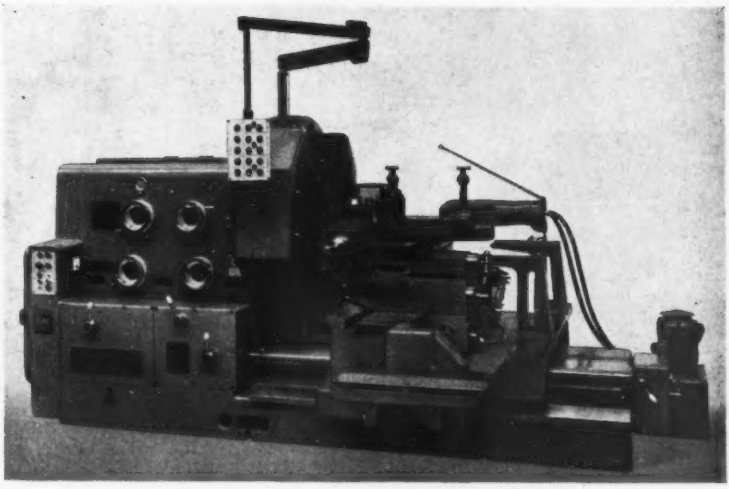


Fig. 6. Two cross-slides are provided on the saddle of the Pontiggia F 80 facing lathe, and the rear slide can be provided with hydraulic copying equipment

In Fig. 6 is shown the type F 80 facing lathe, which has capacity for workpieces weighing up to 3 tons and will swing a maximum diameter of 65 in. A total of 18 speeds from 2·6 to 400 r.p.m. is obtainable for the headstock spindle, which is mounted in double-row roller bearings, and the transmission incorporates hydraulically-operated clutches and a brake. Front and rear cross-slides are mounted on the saddle, and power feeds and a rapid traverse are obtainable independently for these members and for the upper slides. Power feeds are also available for the saddle, which may have a maximum traverse of 67 in. on the bed, and if required, provision can be made for rapid saddle traverse. Equipment can be incorporated to enable screw-cutting to be performed, and a tailstock unit is also available.

A hydraulic copying unit, which is seen mounted on the upper slide of the rear cross-slide, can be supplied as extra equipment, and provides for taking profile cuts in both the longitudinal and transverse directions. Pressure fluid is delivered by a separate, self-contained unit, and copying movements are controlled by a template which is secured to T-slotted arms on brackets at the right-hand side of the saddle.

Designated U 300, the centre lathe which formed the remaining exhibit on this company's stand, is representative of the Ua range. These lathes have centre heights of 10¾, 11⅞, and 13¾ in., and can be supplied with bed lengths to provide maximum distances between centres from 39⅜ to 197 in. On the U 300 type, the drive to the headstock is taken from a 20-h.p. motor, and a total of 24 speeds from 9 to 1,800 r.p.m. is obtainable for the spindle, which runs in double-row roller bearings.

MEYER, ROTH & PASTOR TYPE UB I MULTI-SLIDE FORMING MACHINE

The range of multi-slide automatic wire and strip forming machines made by Meyer, Roth & Pastor, Cologne-Raderbert, West Germany (Soag Machine Tools, Ltd., 7 Juxon Street, London, S.E.11), includes the type UB1 shown in Fig. 7. It will handle wire up to 1 mm. diameter (0·039 in.) and strip up to 0·3 by 4 mm. wide (0·012 by 0·16 in.). The maximum length of feed is 60 mm. (2·36 in.), and production rates up to 300 pieces per min. can be obtained. Drive is taken from a ¼-h.p. motor through multi-step V-belt pulleys and a countershaft arrangement which provides a range of seven speeds.

Material is drawn through a 7-roller straightening attachment by a crank-operated gripper feed mechanism which incorporates a clamp to prevent the wire or strip from moving back during the return stroke of the feed slide. The standard machine is fitted with four bending slides, one mandrel slide, and one mandrel lever. Additional bending slides and attachments can be incorporated for producing complicated parts, and when components are being made from strip material, an

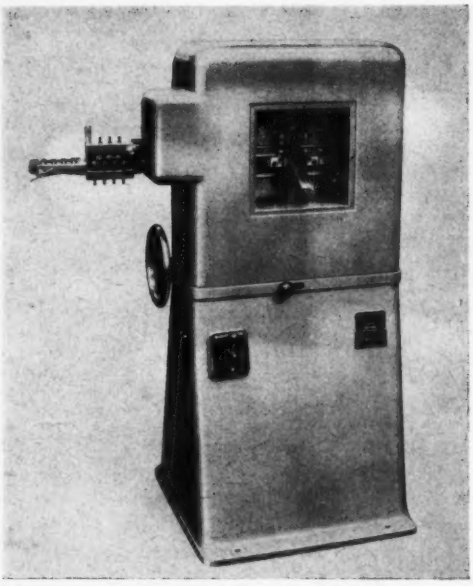


Fig. 7. Meyer, Roth & Pastor type UB1 multi-slide wire and strip forming machine

attachment for embossing, punching, and forming can be fitted. A feature of the design is the ease with which the dogs and cams can be changed when setting up for a different workpiece. The largest machine in the range, designated type UB6, will handle wire up to 6 mm. diameter (0·24 in.) and metal strip up to 1·2 by 40 mm. wide (0·05 by 1·57 in.).

SCHOU NO. 120 LINE BORING MACHINE

Primarily intended for boring crankshaft and camshaft bearings in the crankcases for internal combustion engines, the Schou No. 120 line boring machine (Stedall Machine Tool Co., 192 Pentonville Road, London, N.1) shown in Fig. 8 will accommodate workpieces up to 80 in. long, and is the intermediate size of a range of three machines, for components with maximum lengths from 60 to 100 in.

Boring bars of 1⅞ in. diameter by 70 in. long and 2⅜ in. diameter by 95 in. long are supplied, for machining diameters from 1¾ to 5 in., and a cutter head is available as an extra item, for boring diameters from 5 to 8 in. In operation, the boring bar runs in self-aligning bearings, which are carried by support units at both ends of the workpiece. Provision is made for adjusting these bearings laterally, for aligning the bar with the work, and settings are made with the aid of a centring gauge, which incorporates a dial indicator and is inserted between the wall of the hole to be bored and the surface of the bar.

On each support unit, the bearing is mounted at the upper end of a substantial cylindrical column, which can be adjusted vertically, to obtain maximum and minimum distances of 31¾ and 8¾ in. between the boring bar and the bed, and is carried on a saddle that may be traversed on guideways. Adjustments in both directions are made by means of hand-wheels, and to ensure adequate rigidity, the sleeve in which the column is mounted is extended downwards for a considerable distance. Three sets of parallels are supplied for supporting the work.

Also adjustable vertically by hand, the spindle head is mounted on a further cylindrical column, which slides in a long sleeve bolted to the base. Drive to the head, which incorporates a totally-enclosed, oil bath-lubricated gearbox, is taken from a 2-h.p. motor inside the bed, and steplessly-variable spindle speeds from 75 to 750 r.p.m. are obtainable. The spindle can be traversed axially for a maximum distance of 12 in., at three rates, by means of a capstan wheel at the front of the

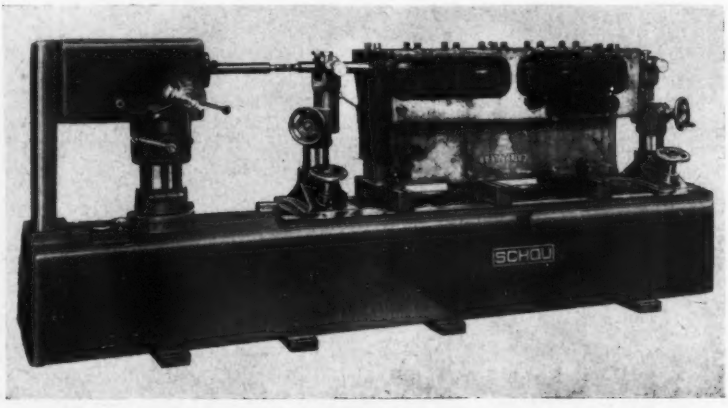


Fig. 8. Schou No. 120 line boring machine

head. A button in the hub of this wheel provides for the engagement of power feed, and rates of 0·0008, 0·0024, and 0·0065 in. per rev. are selected by an adjacent lever.

A setting gauge, which incorporates a high precision dial indicator, is supplied, to facilitate the accurate radial adjustment of multiple cutting tools in the boring bar, and a special measuring instrument is available in two sizes, to enable bored holes from 1⅝ to 4⅛ and 4 to 8 in. diameter to be checked without the need for removing the bar from the work.

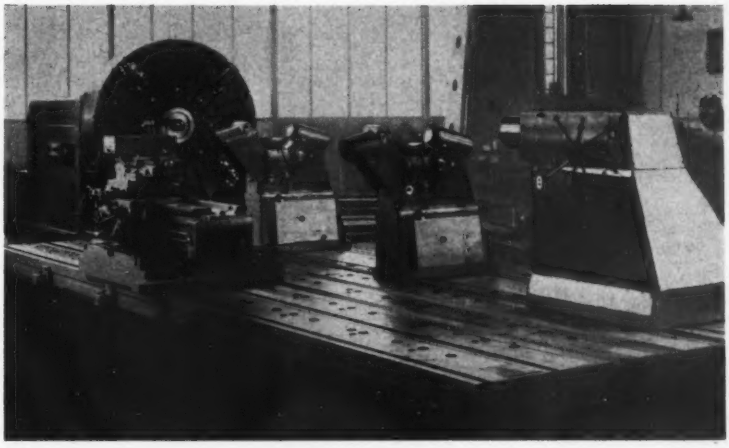


Fig. 9. Ravensburg type P40 faceplate lathe. The bed for the compound tool carriage can be independently positioned on the baseplate

RAVENSBURG TYPE P40 FACEPLATE LATHE WITH BASEPLATE

In Fig. 9 is shown the type P40 faceplate lathe built by Maschinenfabrik Ravensburg A.G. Ravensburg/Wurttemburg, West Germany (Sykes Machine Tool Co., Ltd., The Hythe, Staines, Middlesex). A feature of this machine is that the compound tool carriage is mounted on a separate bed which can be located at various positions on a T-slotted baseplate. The centre height is 5 ft. 3 in., and the faceplate diameter is 6 ft. 7 in.

A pit can be provided between the baseplate and the headstock, where a large swing capacity is required. If smaller workpieces are to be machined, and the pit is not necessary, a bridge-piece can be used to give the same facilities as are afforded by the machine with the continuous baseplate. The width of the pit can be extended by means of a sliding baseplate arrangement which is the subject of a patent application.

A motor of 50 h.p. drives the spindle, and the heavy-duty geared headstock provides 18 speeds from 1·2 to 60 r.p.m., the final drive being transmitted through a pinion to an internal helical rim gear on the faceplate. The spindle runs in adjustable bearings and the journals are hardened. A pump delivers oil through a filter to all gears and bearings.

The feed drive for the tool carriage is related to the spindle rotation electrically by a patented synchronous system which obviates the need for connecting gears and shafts. Two suitably-connected 3-phase slip ring motors of conventional design are employed, and an additional d.c. supply to one phase of each stator winding ensures a stability of transmission which, it is stated, enables screw threads up to 4¾-in. lead to be cut to normal tolerances without difficulty. There are 12 rates of feed, from 0·002 to 0·12 in. per rev., for the carriage on the bed, and 12 rates of surfacing feed, from 0·0016 to 0·1 in. per rev. Adjustable, multiple-disc clutches protect the feed mechanism against overload, and provision can be made for rapid traverse of the carriage, if required.

Switchgear for the various motors is housed in a cabinet at the rear of the machine, and on the standard lathe, drive from the main motor is transmitted to the headstock gearing through a flexible coupling. The motor is controlled from the headstock or tool carriage by a push-button operated, star-delta starter, and braking is effected by d.c. injection, through a brake contactor, as soon as the a.c. is switched off. A jogging switch is provided for inching the faceplate to facilitate loading and removing work. Copying equipment can be supplied for this lathe, if required.

CHRISTEN KB 2 EDGE CHAMFERING MACHINE

In Fig. 10 is seen the type KB 2 edge chamfering machine built by Christen & Co., Ltd., Berne, Switzerland [G. Zwicky (London), Ltd., Zwicky House, 241-247 High Street, London, W.3]. On this machine, the workpiece, of square or rect-

Fig. 10. Christen KB 2 edge chamfering machine

angular section, is moved by hand along a V-way, which is formed by opposing inclined faces on two spaced, hardened and ground steel guides. Downward pressure is applied simultaneously, and the portion of the work which protrudes through the gap between the guides is thus passed across the face of a grinding wheel, which is mounted horizontally. The guides can be adjusted laterally, by means of a lever, to permit of grinding chamfers up to 0·078 in. wide. The chamfers are normally produced at 45 deg., but other interchangeable guides can be supplied to enable different angles to be obtained. Extra equipment available also includes an adjustable table unit, which may be mounted in place of the V-guides, to permit surface grinding of parts up to 2·362 in. wide, with cuts of various depths up to 0·039 in. per pass.

A 6-in. diameter ring-type grinding wheel is employed, with concentric portions at different levels, to permit roughing and finishing cuts to be taken during a single pass. The wheel is mounted directly on the shaft of a dust-proof ¾-h.p. motor, which is adjustable vertically. A fan, also driven from the motor, draws dust from the working area, and delivers it to a removable bag. A lever-operated diamond dressing unit is provided.

BOLEY SECOND-OPERATION LATHES

Second-operation lathes by G. Boley, Esslingen, Germany (Burton, Griffiths & Co., Ltd., Mackadown Lane, Birmingham, 33), include the type 4 HS machine, which has a swing capacity of 2¾ in. and a collet capacity of 1 in. diameter. An air-hydraulic system provides for operation on an automatic cycle, and for the production of large batches, the machine can be set up for fully-automatic working. With the latter arrangement, components are delivered to the working area by a magazine chute, which may be loaded manually or from a hopper feed unit, as seen in Fig. 11. After the completed part has been ejected at the end of a cycle, the component at the lower end of this chute is thrust into the collet by a plunger, which is mounted in a tailstock unit. The collet is then closed, to grip the part in readiness for the next machining cycle.

Spindle speeds available range up to 3,550 r.p.m., and longitudinal and cross travels of 2¾ in. each are provided for the compound tool rest. If required, an additional cross-slide can be fitted, for recessing. Steplessly-variable feeds and a rapid traverse rate are obtainable, and movement of the slides is controlled by fixed stops. The sequence of movements required for the working cycle is set by means of a series of selector switches on a separate cabinet, provision also being made for operating each slide individually. With this arrangement, it is stated, change-over for the production of a different component is simple and rapid. Successive movements are obtained by means of limit switches, which operate a solenoid air valve.

On the type 4HK lathe, workpieces up to 2¾ in. diameter can be gripped and spindle speeds range up to 3,550 r.p.m. To enable operations such as facing, turning external surfaces, boring, and

Fig. 11. The Boley type 4 HS second-operation lathe is here shown set up for fully-automatic working

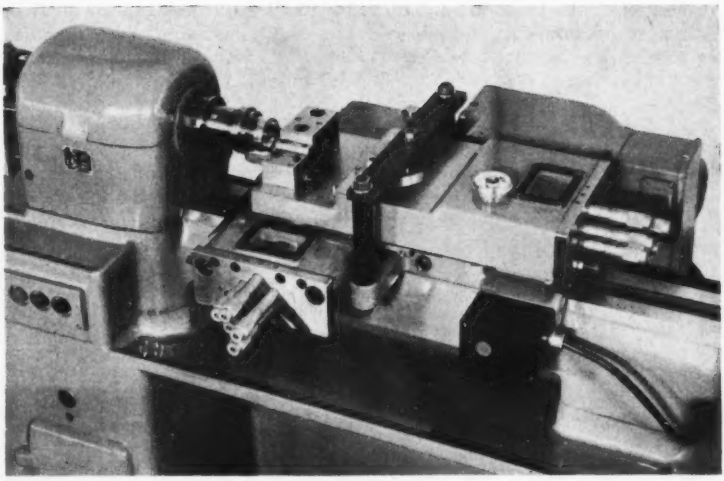


Fig. 12. Close-up view of the compound tool rest on the Boley type 4 HK second-operation lathe

chamfering to be performed, up to five cutting tools can be secured in a holder, which is detachably mounted on a compound rest, as seen in Fig. 12. Longitudinal and cross traverses of 1⅞ in. each are provided, and motion is applied to the slides, in the ratio of 1:1, by means of two cams on a shaft which is turned through 1 rev. during each working cycle. Drive for this shaft is taken from a separate motor, through change gearing which enables cycle times from 4·8 to 150 sec. to be obtained. Movements of each slide are controlled by a total of five stops, which are set with the aid of individual micrometer screws and are brought successively into the working position by means of a camshaft. With this arrangement, the accuracy of the work is not dependent on the traversing cams.

ROCHAUD MILLING MACHINE

Seen on display for the first time, the type FH 60 C horizontal bed-type milling machine shown in Fig. 13 is built by Rochaud & Lamassiaude, Limoges, France (Stanhope Machine Tools, Ltd., 202 Acton Lane, Harlesden, London, N.W.10), and is the smallest of a range of three sizes. The spindle head and overarm are carried on slideways on the front of the column, and have a vertical movement of 13¾ in. An axial movement of 2¾ in. is provided for the spindle, which has a 40 or 50 series nose (to order) and a speed range of 20 to 1,600 r.p.m., drive being taken from a 6- or 8-h.p. motor, as required.

The work-table measures 43¾ by 10¾ in., and has a longitudinal movement of 24½ in., the feed rates ranging from approximately ¾ to 63 in. per min. This machine is intended for quantity production work, and can be set-up to operate on fully-automatic cycles. The larger machines, known as the type FH 80 C, are basically similar except that they have work-tables measuring 47¼ by 12½ or 17¾ in., and 59 by 12½ or 17¾ in. Spindle speeds on these machines range from 25 to 1,250 r.p.m., and the vertical movement of the head is 16½ in. Vertical spindle attachments can be supplied for mounting on machines of all three sizes.

Alternatively, the type FH 80 C machines can be supplied in duplex form, with a column and spindle head at each side of the bed. Again, there are facilities for setting fully-automatic cycles, and control is effected by means of a push-

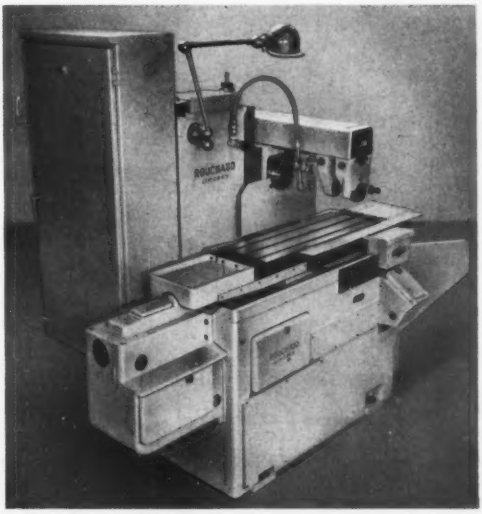


Fig. 13. Rochaud & Lamassiaude FH 60 C bed-type horizontal milling machine

button box which is pivotally mounted at the top of one column. Machines of this type are also available with the columns arranged for transverse movement on wing-type bed members.

MAXNOVO FRONT-O-MEC 23 AUTOMATIC HYDRAULIC CHUCKING LATHE

Maxnovo Meccanica di Precisione S.p.A., Novara, Italy (Catmur Machine Tool Corporation, Ltd., 103 Lancaster Road, London, W.11) introduced the Front-O-Mec 23 automatic-cycle chucking lathe, shown in Fig. 14. This lathe is built on the standardized unit principle, which enables machines for special purposes to be constructed readily. It will swing 18·9 in. over the bed-ways and the maximum turning diameter is 11·8 in.

The bed is cast integral with the headstock and the latter incorporates a heavy-duty spindle which is driven through gears by a motor of 22 h.p. Six, nine, or 12 speeds may be provided in the range from 64 to 1,600 r.p.m., and three speed changes can be made automatically during the cycle. Alternatively, a d.c. motor-generator drive can be incorporated to give steplessly-variable speeds, and as many speed changes as desired can then be obtained during the automatic cycle. The spindle is bored 2 in. diameter and has an ASA 8-in. standard nose.

Independent front and rear tool slides are fitted, the front slide having a longitudinal travel of 9·8 in., or 22·8 in., according to the length of the bed, and a cross travel of 4·9 in. The feed is obtained mechanically from the spindle through an electromagnetic clutch, and there are six rates ranging from 0·0047 to 0·02 in. per rev., or 12, from 0·002 to 0·02 in. per rev. If desired, two automatic feed changes can be made during the cycle. The rapid traverse movements are obtained hydraulically. Both the feed and rapid traverse motions of the rear cross-slide are hydraulically operated, and more than one slide can be fitted, if desired. Provision is made on both front and rear slides for retracting the tools during the rapid return stroke, to avoid marking the work. The travel of the rear cross-slide is 6·3 in., and feed rates up to 0·024 in. per rev. can be applied.

The machine cycle is controlled by a programme unit which can quickly be changed for another already set up for a different work piece. Particular attention has been paid to accessibility of the electrical equipment, and the push-button control panel can be placed at the most convenient position for either front or side loading. If desired, a swarf discharge system suitable for connection to a conveyor can be provided, instead of a removable container, as normally supplied.

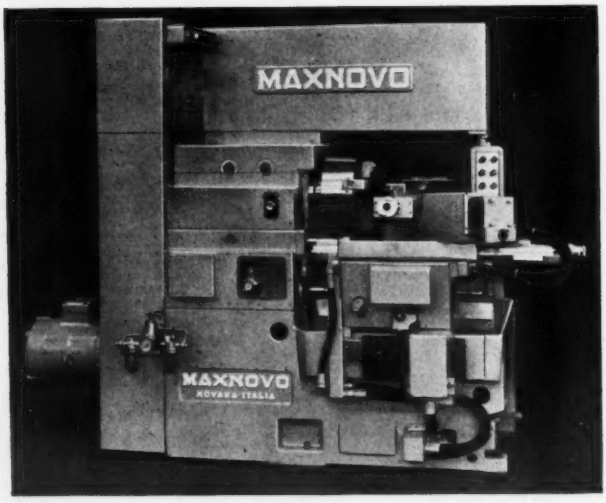


Fig. 14. Maxnovo Front-O-Mec 23 automatic hydraulic chucking lathe

POKORNY HYDROMENT HYDRAULIC RAM UNITS

Frankfurter Maschinenbau AG. (formerly Pokorny & Wittekind), Frankfurt, West Germany (Verrolec, Ltd., 721 North Circular Road, London, N.W.2), make a range of oil-hydraulic ram units known as Hydroments, which can be easily installed in machines and fixtures for supplying power for short-stroke operations. They are available in capacities up to 40 tons and in Fig. 15 is shown an application of a 2½-ton unit, housed in a special yoke, for riveting an aircraft wing component. A similar type of yoke, with a 25-ton unit, has been employed for riveting ½-in. thick drum ends. Hydroments have also been successfully employed for plastics moulding presses, straightening, cutting off, shearing, and perforating.

During the operating cycle, the ram is rapidly advanced until the attached tool makes contact with the work, and a high thrust load is then automatically applied for the actual working stroke. Upon completion of this movement the ram is automatically

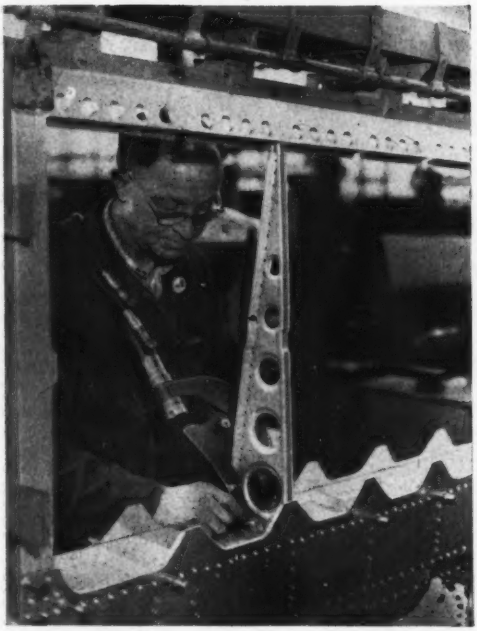


Fig. 15. A 2½-ton Pokorny Hydroment unit, housed in a special yoke, is here being employed for riveting an aircraft wing component

returned to the starting position. Self-contained, motorized hydraulic pump units, of capacities from 1½ to 15¼ gal. per min., are available, which incorporate pressure regulators and solenoid-operated flow control valves. Hydraulic cylinders specially designed for operations involving long strokes at relatively low power can also be supplied.

LANDIS GENDRON CYLINDRICAL GRINDERS

Cylindrical grinders in the R. 16 range built by Landis Gendron, S.A., Villeurbanne (Rhone), France (Stanley Howard, Ltd., 73 Devon Street, Saltley, Birmingham 7), can be supplied for operation on a hand-controlled or an automatic cycle, and with the wheel spindle set at an angle or parallel with the work axis. An example from the range is shown in Fig. 16. A type ROPA 16·50 angle-head machine was displayed at the exhibition set up for grinding small crankshafts.

Work up to 4 in. diameter can be ground, and a maximum length of 20 in. can be accommodated between the centres on the angle-head, and 30 in. on the parallel-head machines. The grinding spindle runs in patented Gerard hydraulic bearings, for which a high degree of precision is claimed, and a single wheel up to 24 in. diameter, or multiple wheels, can be accommodated on machines of the latest type. Drive is taken by V-belts from a 9-h.p. motor, and spindle speeds of 1,130 and 1,260 r.p.m. can be obtained by means of interchangeable pulleys. The machines are primarily intended for plunge grinding operations only, and rapid power traverse and continuous in-feed at steplessly-variable rates down to 0·00004 in. per sec. are applied to a sub-slide which carries the wheel-head, by a hydraulic motor. For rapid traverse, pressure oil is delivered to the hydraulic motor by two gear pumps driven by a single electric motor, but for in-feed, only one pump is employed. Different feeds for rough and finish grinding can be obtained in the ratio of 12 to 1. The wheel-head can be adjusted on guideways on the sub-base by means of a hand-wheel, or automatically in increments from 0·0001 to 0·002 in. per table stroke when the machine is to be employed for traverse grinding. The hand-wheel mechanism incorporates a hydraulic arrangement for eliminating backlash, and there is a ratchet and pawl for very fine adjustment.

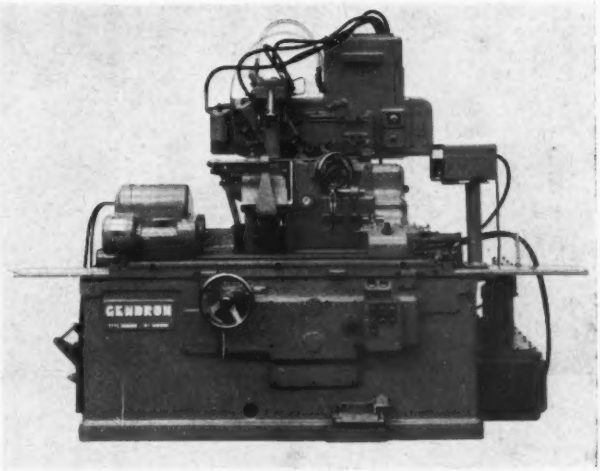


Fig. 16. An example from the Landis Gendron R. 16 range of cylindrical grinders. The grinding spindle runs in patented hydraulic bearings

Mounted on the wheel-head, the template-controlled hydraulic profile dressing attachment incorporates a servo motor, which enables 90 deg. shouldered portions and steep tapers to be formed on the grinding wheel. The horizontal slide runs on hardened V-shaped guideways fitted with needle roller bearings, and the diamond holder, which is set at an angle, has a maximum movement of 2⅝ in. in a direction at right-angles to the wheel spindle on the angle-head, and of 1¾ in. on the parallel-head machines.

Steplessly-variable table speeds from 3 to 160 in. per min. are provided hydraulically for traverse grinding, and the upper part of the table, which carries the work-head and tailstock, can be swivelled through a maximum angle of 10 deg. to enable tapers to be ground. The bed-ways and guideways for the wheel-head and the sub-slide are automatically lubricated by a pressure system which ensures that a film of oil of constant thickness is maintained between the sliding surfaces of these members.

Drive to the work-head is taken from a ½-h.p. single-speed motor, through a belt and stepped pulleys, and six speeds, which may range from 60 to 195 or from 120 to 390 r.p.m., are obtainable. The work-head is normally arranged for dead-centre operation, but a rotating spindle can be provided if required. On machines arranged for automatic operation, an electro-magnetic brake is fitted, which is applied to stop the work at the end of the grinding cycle.

Automatic work sizing equipment can be supplied, which incorporates a dial-type instrument for indicating the reduction in workpiece diameter during the final stage of the grinding cycle. If required, provision can be made for the in-feed motion to be automatically interrupted at a pre-set point in the cycle, under the control of the sizing equipment, to enable a facing cut to be taken on the work. In-feed is re-started by push-button, and if desired, the wheel-head can be caused to dwell at the end of the cycle, for a pre-set period controlled by a timer, for sparking out. A counter can be fitted for automatically initiating the wheel dressing cycle when a pre-set number of parts in the range from 1 to 170 has been ground.

ROWLAND TYPE HDD/C DOUBLE-DISC SURFACE GRINDER

F. E. Rowland & Co., Ltd., Climax Works, Reddish, near Stockport, exhibited a type HDD/C, 20-in., double-disc machine of similar design to that shown in Fig. 17, which has been built for a firm in Italy for grinding, simultaneously, opposite faces on components for refrigerators, to a high degree of accuracy for thickness and flatness. The machine incorporates automatic workpiece sizing equipment, which operates in conjunction with a hydraulic feed compensating arrangement provided for each wheel-head.

Workpieces to be ground are loaded into a V-shaped carrier at the front of the machine, and are passed, one at a time, by a pusher bar operated by a weight, into openings in a rotating disc. The disc serves to traverse them between the grinding wheels. The pusher bar is returned to its left-hand position by an air cylinder when a fresh supply of workpieces is to be loaded into the carrier. Each wheel-head is driven by a 15-h.p. motor. Double-disc grinders of similar design, of 12- and 30-in. sizes, can be supplied, and the latter may have driving motors up to 40-h.p.

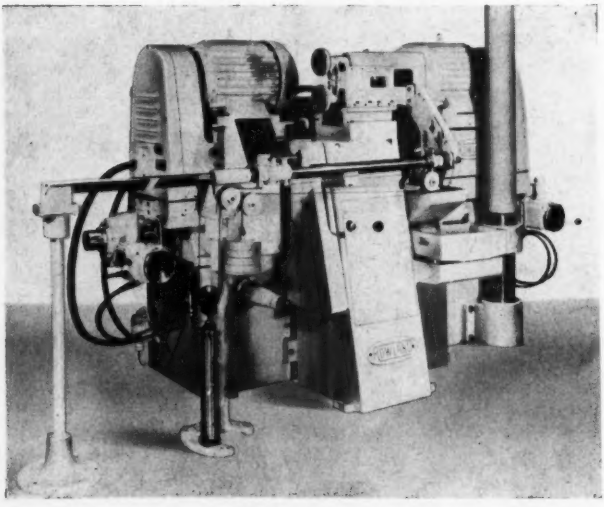


Fig. 17. The Rowland type HDD/C double-disc surface grinder here shown incorporates automatic work loading and sizing equipment

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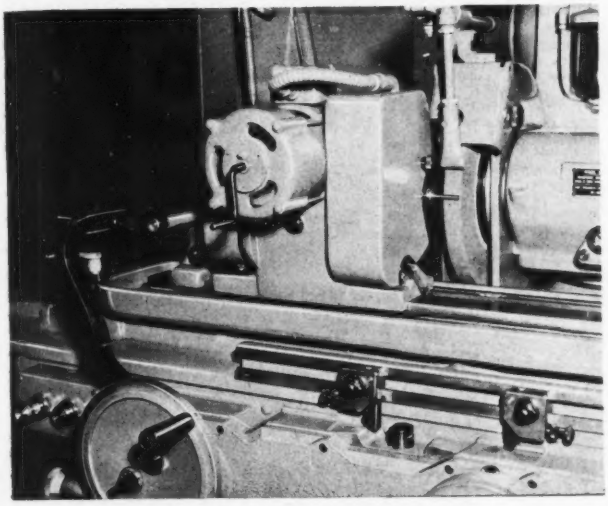
EXPORTS TO BELGIUM of machinery, other than electric, reached a total value of £8,433,760 in the six months ending June 30 this year.

Backing-off Attachment for Jones & Shipman Cylindrical Grinding Machines

A. A. Jones & Shipman, Ltd., Narborough Road South, P.O. Box 89, Leicester, have introduced a backing-off attachment for relief grinding operations on router cutters and other tools, and it is shown in the accompanying illustration set up on one of the company's type 1200E precision cylindrical grinding machines.



Close-up view of a Jones & Shipman type 1200E precision cylindrical grinding machine equipped with a recently introduced backing-off attachment

Drive from the motor to the collet spindle is transmitted by way of gearing, a pawl and ratchet wheel, cams, and a rocker arm. A removable handle is provided on the end of the rotor shaft, for setting the cams in the correct relationship to one another. The speed of the motor is 1,425 r.p.m., and the reduction gearing gives a spindle speed of 84 r.p.m. The feed pawl can be set to rotate the ratchet wheel through one, two, or three teeth, and the corresponding cycle times for one complete revolution of the wheel are 7, 10·5, and 21 sec. The rate of feed per revolution of the spindle depends on the profiles of the cams employed. This attachment is so designed so that the form ground on the workpiece is in the ratio of four to five of that of the rocker cam. When the required relief has been ground, a limit switch is operated by means of the feed cam, to stop the motor.

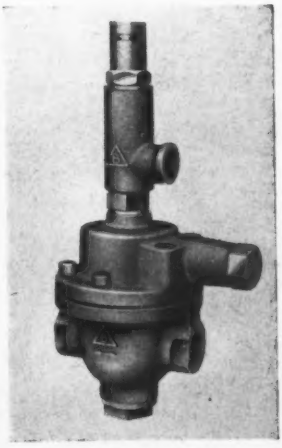
The attachment can also be supplied fitted with a spindle cam in addition to a rocker cam, for relief grinding in two directions simultaneously. With this arrangement, centre drills with double relief, for example, can be ground. For this application, a loading arrangement is provided for correctly locating the centre drills.

The cranked arm seen extending upwards from the machine bed, at the left, serves to actuate a lever whereby the collet is automatically opened when the table is moved to the extreme left.

Bailey Excess-pressure Protection Valve

A new design of excess-pressure protection valve for steam pipelines, as shown in the accompanying illustration, has been introduced by Sir W. H. Bailey & Co., Ltd., Albion Works, Patricroft, Manchester. A feature of this valve is that the steam supply is not cut off completely in an emergency, the downstream reduced pressure being maintained at the preset level so that process work, for example, is not interrupted.

The unit incor-



Bailey excess-pressure protection valve for steam lines

porates a double-beat valve attached to a piston across which a pressure differential is set up if there is any marked increase in inlet pressure. As a result of this differential, the piston is lifted, and the main valve is thus brought closer to the seating faces. Consequently, the downstream line is automatically protected against excess pressure. As soon as the supply pressure returns to normal, the valve automatically resumes its original position.

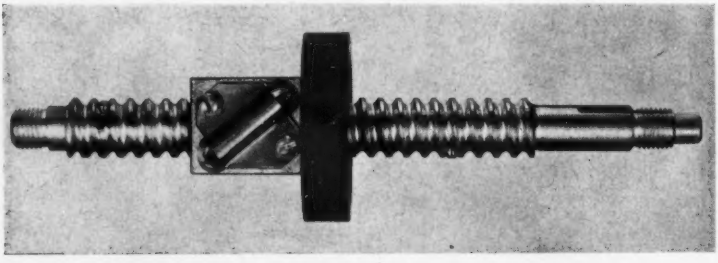
A relief valve is incorporated, which is set to lift at a required safety pressure, and provides for any minor pressure rise. There is also a needle valve adjustment, which enables the performance characteristics of the valve to be matched to a specific application.

These valves are at present available in bronze, with screwed ends to fit ¾-, 1-, 1¼-, 1½-, and 2-in. pipes, and can be employed for pressures up to 150 lb. per sq. in. In an emergency, an inlet pressure up to 300 lb. per sq. in. can be accepted. The spring ranges available are 2 to 10, 10 to 80, and 80 to 150 lb. per sq. in.

New Saginaw Ball Screw Units

The accompanying figure shows a typical ball screw unit from a new range, which has been introduced by the Saginaw Steering Gear Division, General Motors Corporation, Saginaw, Mich., U.S.A. Each of these units has provision for arresting axial movement of the nut in either direction by means of a stop attached to the screw. A free-wheeling device is incorporated in the nut assembly, and with this arrangement, there is no need to interrupt the rotation of the screw.

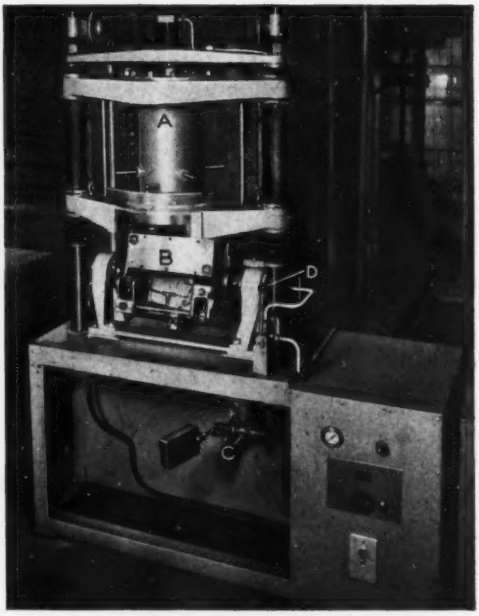
In other respects, the new units are identical with conventional ball screws of the same sizes, and are capable of transmitting similar loads. As an indication of the capacity, it is stated that a unit with a pitch circle diameter of 0·631 in. was tested for 45,000 cycles under a load of 500 lb.



A free-wheeling device in the nut assembly of this Saginaw ball screw unit permits axial movement to be arrested without stopping the screw

Anson 200 Shell Core Making Machine

The Anson 200 shell core making machine shown in the accompanying illustration is made by Anson Industries (Anson Units), Ltd., Methley Road, Whitwood Mere, Castleford. Operated by compressed air at a minimum pressure of 80 lb. per sq. in., it has a capacity for producing 200 cores per hour and will accommodate core boxes up to 10 by 5¼ in. by 2½ in. closed thickness.



The Anson 200 shell core making machine

Resin coated sand is stored in the container *A* which is lowered on to the core box *B*, this movement being controlled by means of the knee-operated pneumatic valve at *C*. The sand is then pneumatically injected into the core box by operation of the

control lever *D*. Heat for curing is provided by a flat plate element of 1,000 watts capacity in each half of the core box.

A box is mounted on each side of a trunnion fixture which is swivelled about a horizontal axis, by hand. An electrical timing device which operates a solenoid air valve controls the curing time, and the temperature is regulated manually from the panel on the right.

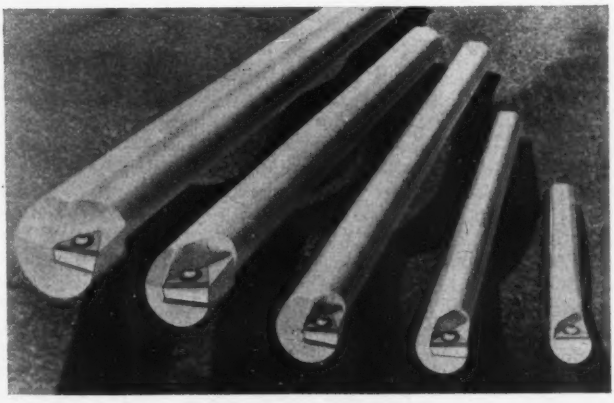
At the end of the curing period, the fixture is turned through 180 deg. to bring the second box to the filling position, and to allow surplus sand within the cured shell to fall away from the other box. By turning the sand container, the machine can be set for producing cores with blowing centres of 3⅜, 4⅜, or 6 in.

To permit rapid removal of the finished cores, the boxes are mounted on carrying plates fitted with pneumatic cylinders, which provide for opening and closing.

The machine can be supplied for semi-automatic operation, if required, and an automatic sand feeder for refilling the container is available.

Kendex BB-7000 K-Bar Boring Bars

The shanks of boring bars in a range which has been introduced recently by Kennametal, Inc., Latrobe, Pa., U.S.A., are made entirely of sintered material, and it is claimed that owing to the rigidity and inherent damping property, vibration during cutting is virtually eliminated, and deflection is much reduced. As a result, bores with good surface finish, and straight within close limits, can be obtained. Known as Kendex BB-7000 K-Bars, they are available in five sizes, with diameters from ⅜ to 1 in. and lengths in four steps from 6 to 12 in., and are designed to accommodate positive rake triangular cutting tips and chip breakers, which are clamped in position.

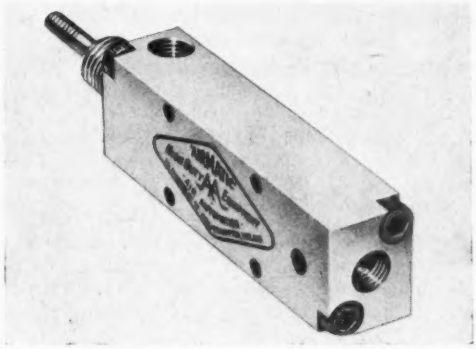


Kendex BB-7000 K-Bar boring bars

Kennametal tools are marketed in this country by Kennametal (Great Britain), Ltd., 82-84 Coleshill Street, Birmingham, 4.

Airmatic ½-in. Bore Air Cylinders

Air Automation, 26 Sharrocks Street, Wolverhampton, Staffs., have recently added to their range of air cylinders the ½-in. bore Airmatic unit shown in the accompanying illustration. This cylinder has a rectangular-section 1-in. by ¾-in. brass body with ⅛-in. B.S.P. ports, and is available with stroke lengths of ½, 1, and 1½ in. It can be supplied as a single-acting or a double-acting type, and the former can be arranged for spring return.



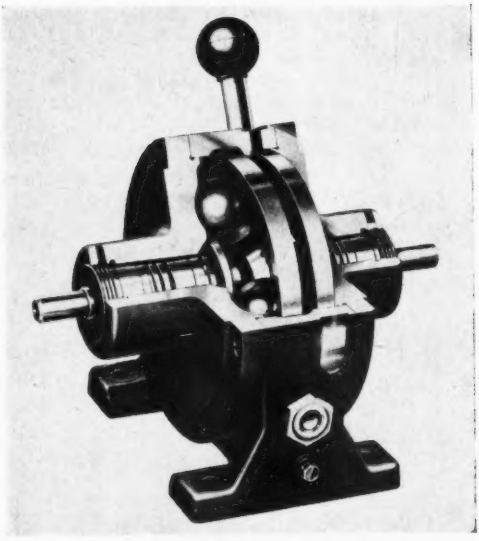
Airmatic ½-in. bore air cylinder

The $\frac{7}{16}$ in. long nose mounting is threaded ¼-in. B.S.P., and there are 4 B.A. clearance holes through the body which provide for side or base mounting. In addition, there are two $\frac{7}{16}$-in. diameter by ⅜-in. deep holes for rear trunnion mounting. The piston rod is of stainless steel, and neoprene distributor-type U-seals are incorporated for both rod and piston. Cylinders of ½-in. bore are also available with ports and 2 B.A. fixing studs in the rear ends, for manifold mounting. A midget flow control valve, designated No. A70M, can be supplied for use with these cylinders.

Making Components for the Kopp Variable-speed Unit

Set-ups and Equipment Employed at the Royal Works of Allspeeds, Ltd., Clayton-le-Moors, Lancs.

By A. W. ASTROP, Associate Editor



THE INCREASING USE of steplessly-variable drive systems of many types has been most marked in the engineering industry during the last decade, and on machine tools in particular the provision of such facilities for regulating spindle speeds and feed rates is rapidly becoming more common. Advantages offered by such arrangements are well-known, and include the ability to maintain constant cutting speed during facing operations, and to select optimum feed rates, as a result of which surface finishes are improved, and cutter life is frequently increased. Steplessly-variable drive systems can broadly be divided into two categories, namely electrical and mechanical, and an interesting unit, in the latter classification, is the Kopp Variator, which is of Swiss origin and was first introduced here about 10 years ago. At that time, sole manufacturing and selling rights for the unit in this country were acquired by John Blake, Ltd., Oakenshaw Works, Accrington, Lancs., a company which was founded in the mid-19th century to manufacture and install a patented form of water-pumping equipment, and is still active in this sphere.

A new company, known as Allspeeds, Ltd., was formed for the purpose of producing the Kopp units in quantity, and initially this work was carried out at the Oakenshaw Works. Recently, however, the company has taken possession of other premises—the Royal Works—which provide a total floor area of 110,000 sq. ft., and are devoted almost entirely to the production of Kopp Variators in a wide range of types and sizes. It is interesting to note that the buildings were originally employed for cotton spinning, and became available as a result of the reorganization of the textile industry in Lancashire. The premises, which are of single storey construction, have been considerably modernized, in that all the original closely-pitched roof stanchions have been removed and replaced by a smaller number. The new arrangement allows for 50-ft. wide bays to be provided in the production section, which has an area of more than 52,000 sq. ft. A new concrete floor, with ironite top dressing, has also been laid.

THE KOPP VARIATOR

The Kopp Variator was the subject of a short article in MACHINERY, 76/709—18/5/50, which was written at the time when it was introduced to this country, and before describing some of the set-ups and equipment employed for producing the various component parts, it may be helpful to recall, briefly, the principle of operation and the broad features of the design. A cut-away view of a typical hand-controlled unit is shown in the heading illustration, where it can be seen that the input and output shafts are coaxial. There is no direct connection between the two shafts, but drive is transmitted by way of a number of steel balls. Each ball is arranged to run freely on a spindle, and for direct drive—with output speed equal to input speed—these spindles are set parallel with the coaxial shafts. Means are provided for tilting the spindles in synchronism, and

as a result the speed of the output shaft relative to the constant speed of the input shaft can be varied steplessly, over a ratio range of 9 to 1.

The geometry of the system is readily apparent from the series of diagrams in Fig. 1. At the inner ends of the input and output shafts there are truncated drive cones, and the conical surfaces of these members are in contact with the steel balls. As mentioned earlier, these balls are free to rotate on spindles, and at *A* in Fig. 1 the spindles are set parallel with the input and output shafts. If the input shaft is rotated, drive is transmitted to the balls at a speed which is proportional to the ratio of the diameters of the contact lines on the drive cone and the balls. It will be evident that if the ball spindles are set parallel, as at *A*, the diameters of the lines of contact on the balls at the output side are equal to those at the input side, and direct drive is obtained.

In the diagram at *B*, the ball spindles are inclined to the maximum in one direction, and the difference in the diameters of the contact lines on the balls is shown by the close-dotted lines. With this setting, the output shaft is driven at one third of the speed of the input shaft. At the other extreme, as shown at *C*, the ball spindles are inclined to the maximum in the opposite direction, and with this setting the speed of the output shaft is three times that of the input shaft. Thus, the design provides for a 3 to 1 speed ratio above and below the constant input speed, and steplessly-variable control is available between these two extremes, since an infinite number of settings can be obtained for the inclination of the ball spindles.

The tendency for the balls to "spread" radially during operation is counteracted by a retaining ring, as at *d* in Fig. 1, which has a spherically ground bore and embraces the balls in much the same manner as the outer race of a ball bearing. Mention may also be made of a pressure device of simple design, which is incorporated to ensure that the drive cones are continually thrust towards each other, to counteract the natural tendency for them to "spread" and to ensure that they are held in close contact with the balls.

The pressure device is shown diagrammatically in Fig. 2, where one drive cone is drawn in section and the other in elevation. Each drive cone has a bore which is larger in diameter than the end portion of the associated shaft, and with this arrangement it is entirely free to be centred by the main driving balls. The rear face of each cone incorporates a number of cam faces, somewhat similar to the teeth provided on a conventional serrated-face clutch. In this instance, however, there are between six and eight faces only, according to the size of the unit, and the angle at which they are inclined to the near face of the cone is of the order of 10 deg. Splined to the associated shaft, there is a collar, as at *E* in Fig. 2, which is provided with a similar set of cam faces. Between this collar and the drive cone are interposed small steel balls, which are restrained by a cage.

In the non-load condition—that is, when the unit is stationary—each of the balls lies between the cam faces of the collar and drive cone, as shown at *X* in Fig. 2. The cones are held in close contact with the main driving balls by means of fairly light spring washers, as at *F*, and these washers impart sufficient axial pre-load to ensure traction when the unit is started up. Immedi-

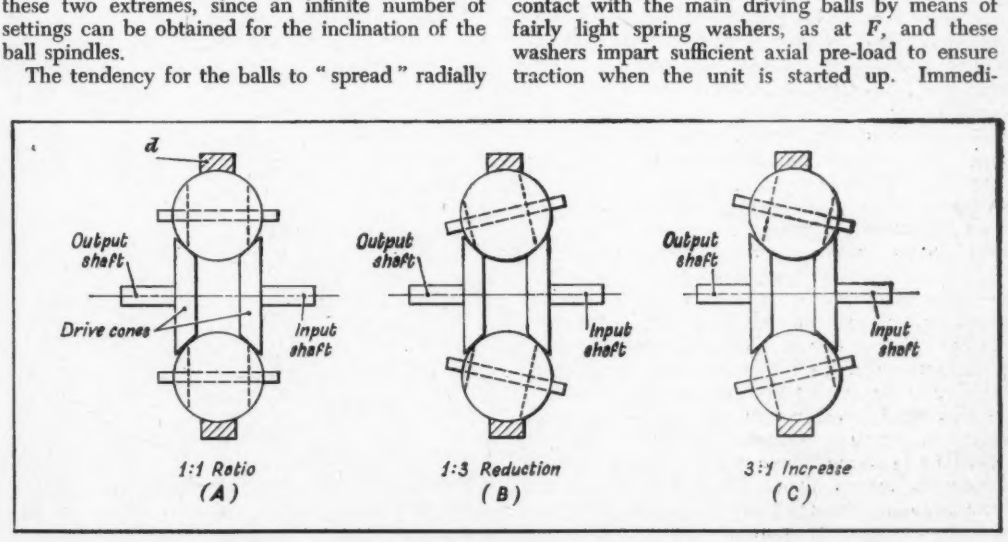


Fig. 1. The principle of operation of the Kopp Variator is here shown diagrammatically

M

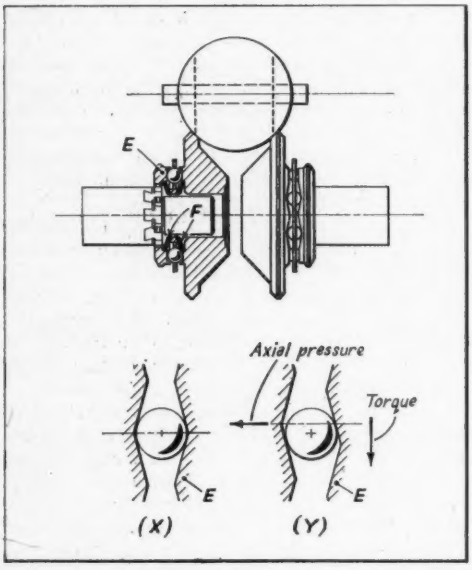


Fig. 2. Sectional and diagrammatic views showing the design and principle of operation of the pressure device incorporated in the Kopp Variator

ately a load is applied, however, the driving cone turns slightly in relation to the collar *E*, and a wedging action occurs between the small balls and the cam faces, as shown at *Y* in Fig. 2. This wedging action serves two purposes, in that it transmits drive from the collar *E* to the cone, and simultaneously forces these two members apart. Since the collar *E* is backed up by the shaft bearings (not shown in Fig. 2) it cannot move axially, and the drive cone is therefore thrust firmly into contact with the main driving balls. As the torque load on the unit increases, moreover, so does the thrust of the cones against the driving balls.

Finally, mention may be made of the means whereby the driving balls are tilted, in synchronism, to vary the output speed as described above. The spindle of each ball extends beyond the periphery at each side, and the ends engage with, and are guided by, arcuate slots machined —substantially radially—in the ends walls of the unit. At one side, however between the end wall and the ring of balls, there is a disc-shaped member known as an iris plate. This plate has arcuate slots machined through the web portion, and there are as many slots as there are driving balls in the unit.

The radius to which each slot is machined is struck from a point off-centre from the bore of the iris plate, and the latter is arranged so that it can be turned through a predetermined number of degrees, in either direction, but is restrained from moving axially. The ball spindles pass through these slots, and when the iris plate is turned the slots act as cam faces and serve to tilt the spindles.

It will be evident that many of the components in the Kopp Variator must be machined to extremely close limits of accuracy. Main driving balls, for example, are produced to within 0·0005 in. for diameter and roundness, and selective assembly is employed to ensure that the balls in each Variator are of the same diameter within 0·0001 in. For the largest unit in the range, a set of eight balls must be found which conforms to this requirement. The company produces main driving balls at the rate of approximately 50,000 per year, to supply its own needs, also those of many Kopp licensees throughout the world, including the U.S.A.

At present, nine different sizes of units are made, with horse-power ratings from ¼ to 15. Units are supplied in this simplest form, as shown in the heading illustration, or with integral flange-mounted motors, with or without reduction gearboxes, and for horizontal or vertical applications. A wide variety of systems is also available for turning the iris plate to vary the output speed, ranging from a simple hand-operated lever to remote control by way of a flexible cable or a fractional horse-power electric motor attached to the unit and started and stopped by push-buttons.

A more recent development is fully-automatic control by way of a feed-back system. In one application of such a unit, constant linear speed is provided for a winding machine. The linear speed of the material being wound is monitored continuously by a tachometer, which transmits electrical signals to a Kopp Variator as the speed tends to increase as a result of build-up on the take-up reel. With this arrangement, the speed of the take-up reel is progressively reduced, to take account of the increased diameter of the material thereon. This system also has obvious applications to wire drawing and coiling machines.

PRODUCING MAIN DRIVE BALLS

A total of six different sizes of main drive balls is in continuous production at the Royal Works, namely, 1·000, 1·625, 2·283, 2·755, 3·277 and 3·242 in. diameter, the last-mentioned size being for supply to the U.S.A. for incorporation in the largest size of Kopp Variator made in that country. The balls are made from bought-out solid steel forgings, and the first operation is centreless grind-

ing, during which the complete surface is ground and the slight forging flash is removed. For this operation, a Cincinnati centreless machine is employed which has been the subject of a number of interesting modifications carried out by All-speeds, Ltd. A general view of this machine is shown in Fig. 3, and two 2¾-in. diameter ball forgings are indicated at *G*. The grinding head, at the left, is equipped with a 24-in. diameter wheel, which is edge-dressed to the required arcuate form by means of a special truing attachment which will be described later. Plain peripheral truing is carried out with the dresser seen projecting from the wheel guard, at the extreme left.

In the close-up view, Fig. 4, can be seen the special work-loading device which has been designed by the company for holding the rough forgings and lowering them into position between the grinding and control wheels. The arm *H*, of rectangular section mild steel, is free to pivot at one end of the connecting piece *J*, and the other end of the latter, in turn, is free to pivot on a bracket bolted to the control wheel slide. At the outer end of the arm *H* there is a ball knob (as can be seen in Fig. 3) and another ball knob is provided on a short extension piece, as at *K*. To the inner end of the arm *H* is secured a ring member *L*. The upper face of this ring is chamfered internally, to form a saucer-like shape, and there are

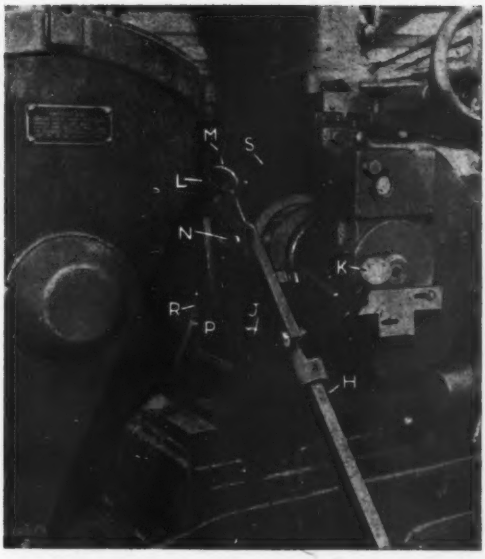


Fig. 4. In this close-up view can be seen the special arm whereby the balls are loaded and unloaded on the centreless grinding machine. The ball to be ground nests in the ring *L*

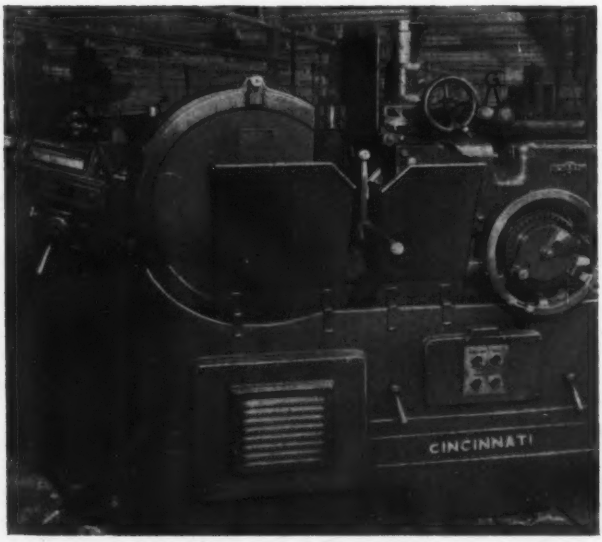


Fig. 3. This Cincinnati centreless grinding machine has been specially modified for operations on forgings for main drive balls

two upwardly-projecting fingers, as at *M*, which are approximately diametrically-opposite.

At the start of the centreless grinding operation, a rough forged ball is placed in the ring *L*, where it rests in the saucer portion and is prevented from rolling out by the lower of the two arms *M*. To bring the forging to the grinding position, the arm *H* is first moved in a direction away from the operator, who grasps the knob *K* in his right hand, and the other knob in his left hand.

Forward movement of the arm *H* is limited by the peg *N*, which projects from the left-hand side and engages with a slot in the gate member *P*. The arm *H* is pushed forward until the peg *N* abuts the end of the horizontal portion of the slot, and is then tilted, to lower the inner end, and thus bring the work into the grinding position. This tilting movement is limited and guided by the action of the peg *N* in the nearly-vertical slot in the gate member *P*. Fig. 5 is

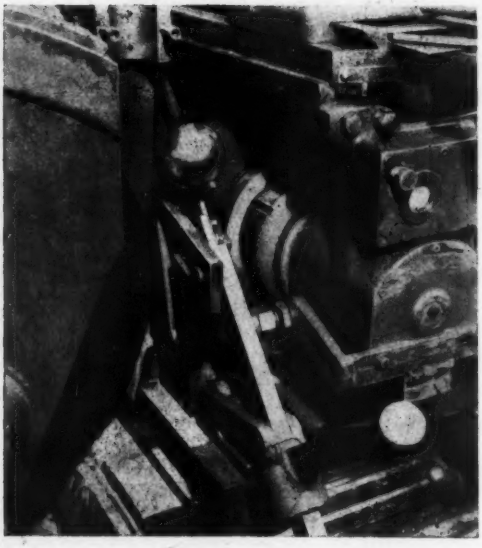


Fig. 5. A centreless-ground ball is here seen being removed from the machine

another close-up view of the working area, but with a centreless-ground ball in place on the arm *H* in readiness for unloading.

In the grinding position, the ball is supported by a carbide-tipped pillar, that has been substituted for the conventional work rest on the machine and of which a small portion can be seen at *R*. The travel of the arm *H* in the downward direction is such that the ring *L* passes over—and partially down—the pillar *R*, leaving the forging resting on top of the latter. With this arrangement, the ring *L* is brought clear of the ball, which is then supported at three points, namely, by the pillar *R*, the grinding wheel, and the control wheel. The carbide pad on the top face of the pillar *R* is inclined at a small angle, with the low side towards the control wheel. At the start of the grinding operation, the forging is off-centre from the pillar *R*, to the right, and is resting on the lower portion of the carbide pad. As grinding proceeds, and the ball decreases in size, it is progressively moved to the left, by the in-feed motion of the control wheel. It is thus forced up the slope of the pad on the pillar *R* and the centre height is kept coincident with that of the wheels.

The control wheel, which is of special design, has an arcuate groove in the periphery, similar to that provided in the grinding wheel, and part of this groove is indicated at *S* in Fig. 4. It is not mounted normal to the spindle, in the conventional manner, however, but is tilted slightly, being secured to a special sleeve-type adaptor, the bore of which is machined at the required angle to the periphery. The angle is such that when the arcuate groove is dressed in the control wheel in a plane normal to the spindle axis, the groove breaks out alternately, at a fixed pitch, first on one side of the wheel and then the other.

In operation, therefore, the control wheel "wobbles," although the arcuate groove runs true with that provided in the periphery of the grinding wheel. The result of this arrangement is that the ball is alternately rotated about a *vertical* axis, first in one direction and then the other, by virtue of the fact that the "wrap-round" of the arcuate groove is constantly changing, being greater first on one side and then on the other. This partial rotation of the forging about the vertical axis is superimposed on the continuous rotation about the horizontal axis, which is normal in centreless grinding, and ensures that the entire surface of the sphere is ground, although the arcuate grooves in the wheels do not completely embrace the ball.

The grooves in the grinding and control wheels are dressed with the aid of a special attachment in the form of a heavy-section cylindrical steel bar from which the diamond projects radially. This bar is inserted vertically between the wheels, and is supported in a special bracket, indicated at *T* in Fig. 5. This bracket incorporates two half bearings, which are widely spaced, and conventional bearing caps, secured by screws, retain the bar, which is then rotated about its longitudinal axis to dress the required matching forms on the wheels.

PIERCING AND BORING THE DRIVE BALLS

When assembled into the Kopp unit, each drive ball is arranged to rotate freely on a spindle, and in some units INA needle-roller bearings are provided. Each ball, therefore, requires to be drilled and bored, and these operations are carried out on Ward type 2C capstan lathes. A typical set-up for a 2¼-in. diameter ball is shown in the close-up view Fig. 6. The centreless-ground ball is delivered to this machine direct from the Cincinnati set-up just described, and is held in specially-shaped jaws in a self-centring air-operated chuck. All six faces of the turret are used, and the earlier stations provide for centring and rough- and finish-drilling. The finishing drill is seen in the working position in the figure, and the next operation is performed by the single-point boring tool indicated at *A*. This tool is carried on a slide which provides for transverse movement, for relieving the drilled bore of the ball.

Before the tool is introduced into the work it is set to a zero position, by means of the fluted knob *B*. The turret slide is then advanced to a predetermined point, and the tool bar *A* is moved transversely—again by the knob *B*—to apply radial feed. Next, the turret is advanced to machine a relief in the bore to the required length, and the tool is returned to the zero position before it is withdrawn. Finally, the bore is reamed with the tool nearest to the camera.

The tool employed for the initial centring operation is fed to such a depth that a small chamfer is left at the mouth of the hole after it has been brought to the finished size, and a similar chamfer is required to be machined at the other end. For this operation, the ball is removed from the chuck, reversed, and slipped over the end of the mandrel *C*, which projects from one face of the turret. The latter is then indexed to bring the mandrel *C* to the working position, and the turret slide is advanced until the work is within the chuck jaws, which are then closed. With this arrangement, the ball is gripped with the previously-machined bore accurately in line with the spindle. Finally, the centring drill, indicated at *D*, is advanced to chamfer the mouth of the hole. At this set-up, the bearing portions of the bore are held to a tolerance of 0·0005 in. on diameter, and within 0·006 in. total indicator reading for concentricity with the ground surface of the sphere.

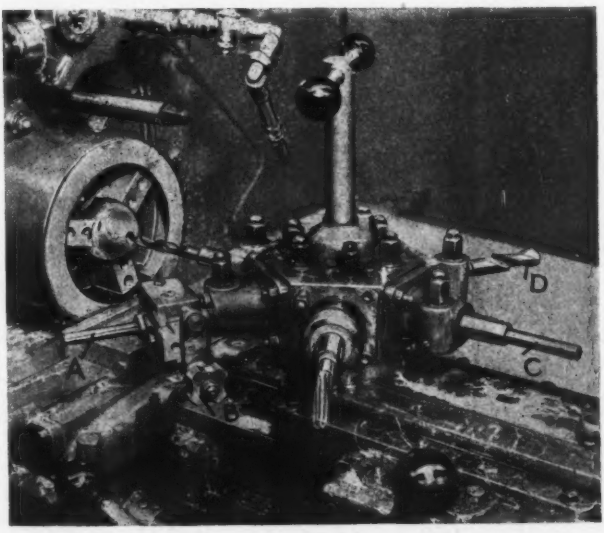


Fig. 6. After centreless grinding, the spindle holes of the balls are drilled and reamed on this Ward 2C machine, and a relief is machined in the bore

Fig. 7. Main drive balls are super-finished on this special machine which was designed and built by the company. Cast iron laps are employed and a surface finish of 1 to 2½micro-inches is obtained

From the Ward capstan lathes, the balls are passed for heat-treatment, thence to a battery of special purpose grinding machines, on which the outside surfaces are ground to close limits for form and diameter. A number of fine-grinding machines of the vertical twin opposed-wheel type are employed to bring the balls to closer limits for sphericity and diameter, and they are finally delivered to the super-finishing section. Typical of the equipment provided in this area is the special machine shown in Fig. 7.

SPECIAL LAPPING MACHINE

Designed and built by the company, this machine is of simple basic construction, and comprises two heavy-section cast-iron lapping wheels, in each of which there is an arcuate groove. Drive can be transmitted to either or both laps, in the same or opposite directions, and the upper lap can be raised, as shown in the figure, for loading and unloading the work, also to permit in-process inspection. In operation, pressure is

Fig. 8. A view in the company's inspection department, where main drive balls are checked on a 100 per cent basis

applied to the balls by the weight of the upper lap, and, if required, this pressure can be increased by an arrangement which provides for loading the top lap downwards.

A number of balls is processed at a time on this machine, and they are maintained at regular spacing by a "cage" with oversize holes. The finish imparted to the balls at this operation is of the order of 1 to 2 micro-inches, and extensive trials were necessary to find a suitable material for the spider. The material must be sufficiently rigid for the duty, and have a reasonable working life, but must not mark the balls. A typical processing time for a set of balls in this super-finishing machine is 4 hours.

INSPECTION DEPARTMENT

Main drive balls are inspected on a 100 per cent basis from the standpoints of dimensional accuracy, form, concentricity of the bore with the spherical surface, finish of the bore, and finish of the spherical surface. A view in the inspection department is shown in Fig. 8, where a number of balls of different sizes is seen in trays in the foreground. These balls are awaiting inspection, and are kept in wooden trays provided with floors of corrugated aluminium. Protective paper is laid in the trays, and the balls rest in the corrugations, which ensure that they do not roll about unduly.

The inspector at the centre is responsible for checking the size of the bore, also its concentricity to the spherical surface, and both these values must be within $\pm 0{\cdot}00025$ in. For checking concentricity, each ball is slipped over one of a number of pegs which protrude from the desk-type stand immediately in front of the operator. The various pegs cater for the different sizes of balls, and there is a dial indicator which is slidably mounted on a steel rail extending along the top edge of the stand. A ball is slipped over the appropriate peg, and is allowed to slide down until it abuts a shoulder, and the height of this shoulder relative to the rail is such as to bring the centre of the ball into line with the stylus of the dial indicator. The ball is then spun on the peg, and any errors of

Fig. 9. The spherical surface is inspected for finish with the aid of a magnifying glass provided with side lighting

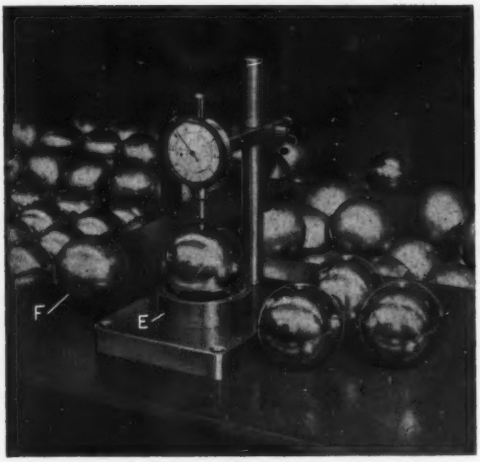


Fig. 10. Typical comparator for checking the size of main drive balls against the master ball at the left

concentrity are read on the indicator. At this station, the surface finish of the bore is also checked, visually.

The inspector at the centre then passes accepted balls to the right and left, where they are taken by other inspectors who check the surface finish of the spherical portions. These inspectors work in small cubicles, which are enclosed on three sides. The fourth side of each cubicle is provided with a black curtain, which can be drawn behind the inspector to exclude extraneous light. A close-up view of an inspector at work in one of these cubicles is given in Fig. 9, where it will be seen that she is provided with a large-diameter stand-mounted magnifying glass arranged for side lighting of the object.

The entire spherical surface is scrutinized, and balls are rejected for hair line marks which are not readily visible to an inexperienced viewer even with the aid of the magnifying glass and powerful lighting. Balls which pass this stage are then diverted to another section of the inspection department, where they are accurately sized and graded. For this operation, each ball is compared with a master ball on equipment of the type shown in Fig. 10. The ball is placed in a special saucer-shaped holder, as at *E*, which is provided with three small balls which are let into, and project from, the surface. The ball to be inspected is thus supported at three points, and can be rotated freely beneath the plunger of the dial indicator. The latter is first set to zero by means of the master ball for the size group, indicated at *F*.

The balls are segregated into sets of the required number, according to the size of Kopp unit in which they will be assembled, and the balls in any set must not vary from each other by more than 0·0001 in. on diameter. Individual balls of a set are then wrapped in a special impregnated paper, which inhibits corrosion, and are passed to the assembly department in special trays.

In a second article, reference will be made to other set-ups for component parts for Kopp Variators, and in particular, attention will be drawn to examples of "combined operations" on capstan lathes, which provide for transverse drilling, also milling, in addition to the more orthodox machining stages.

Sterlicon Sterling to Decimal Conversion Machine

In the accompanying illustration is shown the Sterlicon sterling to decimal conversion machine for which the sole distributors are Lows Calculators, Ltd., 180 Tottenham Court Road, London, W.1. This unit has been designed as an aid to the use of calculating machines when the latter are being employed for the multiplication and division of sterling. It is operated manually by the two knurled wheels on the left, and avoids the eye strain associated with the reading of decimal tables. In addition, it is claimed, there is less risk of error.

The machine, which is only 6¾ in. long, is available as the type I, giving decimal equivalents from ½d. to 19s. 11½d. to five places of decimals, and as the type II, which has the same range but gives the equivalents to six decimal places.

The world concessionaires for the Sterlicon are Vaughan Associates, Ltd., 4 Queen Street, London, W.1.

Sterlicon sterling to decimal conversion machine for use as an accessory to a calculating machine

Diagnosis of Three-phase Motor Troubles

By J. L. WATTS

IMPENDING BREAKDOWNS of polyphase electric motors frequently give rise to such symptoms as tripping of the control gear, faulty starting, or overheating. It is very desirable that such symptoms should be studied carefully, to enable the causes to be diagnosed and remedied. In this way, many breakdowns and much inconvenience can be avoided.

It is of considerable assistance in this connection if the engineer has available an ammeter of the clip-on or "tong-test" type, and preferably also a voltmeter and ohm-meter. Electrical values can be measured fairly simply, and the results of such measurements may be of great value in deducing the causes of abnormalities.

PROTECTIVE DEVICES

Each 3-phase motor of ½ h.p. or over should be protected by an under-voltage release, overload releases, and an over-current protective device such as a set of fuses. Alternatively, one over-current device may be used to protect a group of small motors having a total rating of not more than 15 amp. The function of these devices is to switch off a motor if unsafe conditions arise.

It should be remembered, however, that these devices may stop a motor prematurely if they themselves are defective in some way. Thus, if a motor is automatically switched out for no apparent reason, it may be desirable to examine the protective devices. For instance, a fuse may melt prematurely if it is too small to carry the starting current of the motor. Table 1 gives suitable ratings of cartridge fuses for various types of 415-volt starters and motors. It is most important that the fuses of a set for protecting a 3-phase motor should be of the same rating for each pole. A motor may become burnt out if it is left connected to the supply by fuses in two lines, after a smaller fuse in the third line has melted. A fuse may also melt prematurely on account of heating at a bad connection on the fuse carrier or base contact, or because the fuse contacts are soft, burnt, dirty, rough, or incorrectly adjusted.

Overload releases may, of course, allow a starter to trip-out prematurely if they have too low a current rating or are set at too low a value. It is suggested that the overload releases for a motor with a C.R.P.O. (continuous rating permitting overload) be set to operate if the current is maintained at 25 per cent above the rated full-load current, and that overload releases for the newer motors having a C.M.R. (continuous maximum rating) in accord-

TABLE 1. SUGGESTED SIZES OF FUSES FOR THE PROTECTION OF 415-VOLT 3-PHASE MOTOR CIRCUITS

Rated horse-power	Rating of cartridge fuses for direct-on-line starters, and for standard motors with auto-transformer starters (75 per cent voltage taps)	Rating of cartridge fuses for other starters and motors,
	Amp.	Amp.
1	6	6
3	15	10
5	25	15
7½	30	15
10	50	25
15	60	30
20	80	50
30	100	60
40	160	80
50	200	100
60	200	125
75	200	160

TABLE 2. APPROXIMATE FULL-LOAD CURRENTS OF TYPICAL 3-PHASE MOTORS

Rated horse-power	Full-load current of a 400-volt motor	Full-load current of a 415-volt motor	Full-load current of a 440-volt motor
	Amp.	Amp.	Amp.
0·5	0·9	0·87	0·8
1	1·75	1·68	1·6
2	3·5	3·15	3
3	5	4·7	4·5
4	7	6·3	6
5	8	7·8	7·5
6	9·5	9·2	9
7	11	10·6	10
7·5	11·5	11·1	10·5
8	12	11·7	11
9	13·5	13	12·5
10	15·5	15	13·5
12	17·5	16·8	16
12·5	18·5	17·8	16·5
15	21·5	20·7	20
20	28	27	26
25	35	34	32
30	42	40·5	38
35	50	48	45
40	57	55	53
45	63	61	58
50	68	66	63
55	76	73	69
60	83	80	75
65	88	85	80
70	95	92	87

ance with B.S. 2613 be set to trip at 10 per cent sustained excess current. Table 2 provides a guide to the full load currents of motors if the values are not marked on the nameplates.

For close overload setting, without risk of premature tripping, the overload protective gear must be carefully selected. B.S. 587 (Motor Starters and Controllers) allows an operating tolerance up to ±10 per cent of the overload setting, and some releases may therefore trip prematurely on 90 per cent of the expected current value.

Thermal releases may also trip-out a starter, when there is no danger to the protected motor, due to heating at a faulty connection to an overload element, or to a catch or bi-metal strip being bent. It follows that the connections must be kept clean and tight and the releases correctly adjusted in accordance with the makers' instructions. A thermal overload release may also trip on less than the set value of current if fitted in a hot position, unless it is of a type which is automatically compensated for varying ambient temperature. An electromagnetic overload release may trip a starter prematurely if the time-lag setting is too short or if the oil in the time-lag dash-pot is too thin, or is in a dirty condition.

SHORT-CIRCUITS AND EARTH FAULTS

The most common cause of fuses melting or overload releases tripping, however, is excessive current, against which they are designed to provide protection. In the event of a severe short circuit (failure of insulation between conductors) the fuses may melt, or the overload releases may come into operation, immediately the starter is switched on, and the same applies if there is a serious earth fault (failure of insulation between conductors and earthed casing or sheathing) in the motor circuit.

It should be noted that a short-circuit on the secondary circuit of a motor—for example, on the rotor circuit of a slip-ring motor—will have similar effects to a short-circuit on the stator during starting. This situation might arise if a slip-ring motor were switched on to the supply with the slip rings short-circuited because the rotor starter was in the running position, or because short-circuiting contacts were in contact with the slip rings. A short-circuit on the rotor windings of a slip-ring motor is indicated if the motor attempts to start when the stator switch is closed with the brushes removed from the slip rings and the slip-ring short-circuiting contacts (if fitted) clear of the rings. If the rotor windings are free from short-circuits, the motor may hum, but will not start under these conditions.

Short-circuits or earth faults of lower degree may result in operation of the fuses or overload releases shortly after switching on, or may not cause them to operate at all. The probable indication of such a short-circuit or earth fault is a

TABLE 3. SUMMARY OF CAUSES OF OVERHEATING OF 3-PHASE MOTORS

Effects	Line current inputs to motor starter	Phase voltages at motor terminals	Possible causes
Overheating on load	Normal value and equal	Normal value and equal	Faulty ventilation. Faulty starting or too frequent starting. Excessive operation of a short-time rated motor
Overheating on load	Normal value and equal	Normal value and equal at starter. Low value and equal at motor	Starting operation not completed. Wrongly-connected motor (star instead of delta)
Overheating on load	Excessive value and equal	Normal value and equal	Mechanical overload outside or inside motor
Overheating on load	Excessive value and equal	Low value and equal	Supply fault—incorrect transformer tappings. Cables too small
Overheating on load and possibly on light load	Excessive value and equal	High value and equal	Incorrect transformer tappings. Wrongly-connected motor (delta instead of star)
Overheating on load	Unequal	Unequal	Supply fault—unbalanced single-phase loads, high resistance in one line, open circuit in one line to two or more motors
Overheating on load. Motor not self starting	Equal in two supply lines, zero in the third line	Unequal on motor side of the open circuit, normal and equal on the supply side	Open circuit in one line to the motor
Overheating on load. Motor not self starting	Equal in two supply lines, zero in the third line	Normal value and equal	Open circuit in one phase of star-connected stator windings
Overheating on load	Equal in two supply lines, higher current in the third line	Normal value and equal	Open circuit in one phase of delta-connected stator windings
Overheating of parts of motor on all loads	Unequal	Normal value and equal	Short-circuit or earth fault

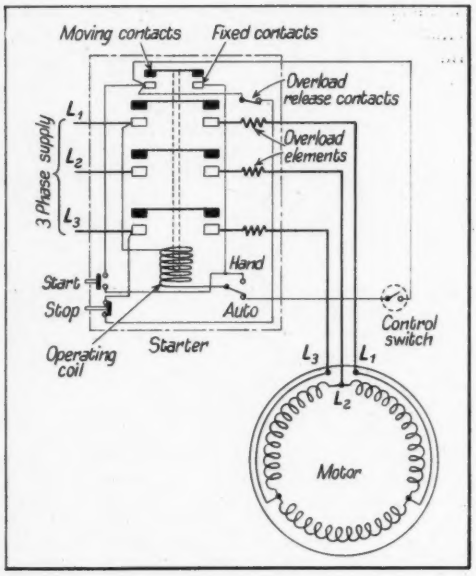


Fig. 1. Connections of a 3-phase motor with a direct-on-line coil-operated starter

smell of burning, and possibly emission of smoke, with discolouration and embrittlement of the insulation of the faulty coil. As indicated in Table 3, the currents in the three lines feeding the motor terminals L_1, L_2 and L_3 (Fig. 1) will then be somewhat unequal when the motor is running, for equal voltages between the phase terminals. The currents can be measured with an ammeter, and the voltages by means of a voltmeter connected in turn between the motor terminals L_1 and L_2, L_1 and L_3, and L_2 and L_3. If the stator windings are short-circuited the resistance between the motor terminals L_1-L_2, L_1-L_3, and L_2-L_3 will also be somewhat unequal when measured with an ohm-meter. A short-circuit or earth fault in a motor almost invariably necessitates some rewinding.

An earth fault in a motor may be detected by connecting a mains-voltage lamp *P* between the "live" pole of a supply (with an earthed neutral) and the terminals of the motor, the case of which is earthed, as indicated at *a* in Fig. 2. A much better arrangement, however, is to use a test lamp *R* which is fed through a double-wound transformer of one-to-one ratio from an a.c. supply, as at *b* in Fig. 2. In either case an earth fault will be indicated by the lighting of the test lamp.

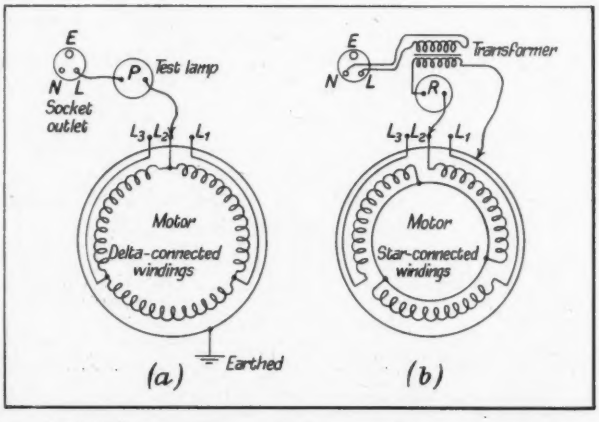


Fig. 2. Diagrams showing methods of testing for an earth fault on stator windings

FAULTY STARTING

The overload releases, or possibly the fuses, may operate very soon after a motor has been switched on if it fails to start, or fails to accelerate quickly to full speed. Starting current of a squirrel-cage motor is normally much greater than the full-load running current, particularly if it is started by direct-on-line switching. As the motor accelerates from rest the current falls, as shown in Fig. 3, which relates to two types of squirrel-cage motors. The heat generated in the windings is proportional to current^2, and damage may be caused by overheating if the starting period is unduly prolonged.

With starters of other types, the operation of overload releases soon after starting may be due to a motor being started too quickly. Timing relays of such automatic starters should be adjusted to bring in the next starting stage only after the motor has reached a steady speed, and thus a steady current, at the previous stage.

AN OPEN-CIRCUIT MAY PREVENT STARTING

A motor may fail to start correctly if there is a short-circuit or earth fault, but it will merely hum and refuse to start at all if there is an open-circuit in one supply line. One method of testing for such a fault, or for an open-circuit in star-connected motor windings, is to spin the motor round by hand (pre-

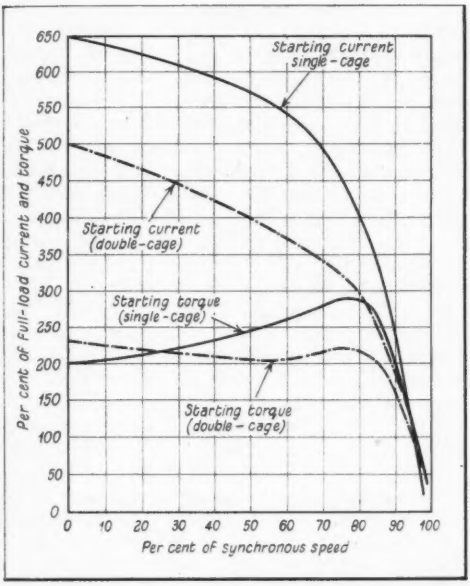


Fig. 3. Curves showing direct-on-line starting conditions with 3-phase squirrel-cage motors of the single- and double-cage types

ferably unloaded) before switching on. If there is such an open-circuit the motor will then run in whichever direction it has been rotated. As indicated in Table 3, under these conditions there will be zero current in one supply line, with equal currents in the two sound lines.

Another method of testing the supply to the motor starter is by connecting two lamps (of phase-to-neutral voltage) in series between the incoming terminals L_1-L_2, L_1-L_3, and L_2-L_3 of the starter, in turn, as shown in Fig. 4. If there is an open-circuit in the supply to the starter the test lamps will light only when connected to the two terminals associated with the two sound lines. If there is also a short-circuit on the supply, as in Fig. 4, the test lamps will light when connected between two pairs of terminals, but not when connected between the short-circuited lines.

The same method can be used to test for an open-circuit or a short-circuit on the feed to the motor itself, by connecting the lamps to the motor leads after they have been disconnected from the motor terminals. An open-circuit may be due, for example, to a fused conductor, melted fuse, or faulty contact or connection at some point in the supply to the motor. It should be noted that if there is an open-circuit in some type of starter other than the direct-on-line pattern it may occur only when the starter is in one position.

STARTING TORQUE

A motor may also fail to start properly if the starting torque is too low, or if it is overloaded. As indicated in Fig. 3, the starting torque of a motor of given horse-power and speed depends on its design, but the starting torque of any motor will be reduced if the voltage is low on some or all of the phases, or if the rated voltage of the motor is too high. The voltage at the motor terminals may be checked by voltmeter. Low voltage may be the result of a supply fault, use of the wrong tappings on a supply transformer, or motor feeding cables of insufficient size. Unequal voltages may be due to a supply fault; single-phase loads not being equally balanced between the phases; a high-resistance contact or connection at some point in the circuit; or an open circuit in a supply line to a distribution point feeding one or more other motors. The latter fault would be indicated if all the motors fed from that distribution point failed to re-start after they had all been switched off.

OVERLOAD

Overload on a motor may be responsible for slow starting. It may be due to the rotor rubbing on the stator because a bearing has worn; a bent shaft; a loose rotor or stator core; projecting core laminations; a partially seized bearing; foreign matter in

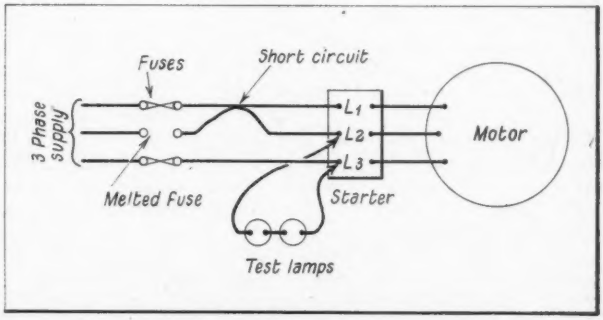


Fig. 4. Diagram showing a method of testing the supply at a motor starter

TABLE 4. MAXIMUM PERMISSIBLE TEMPERATURES (MEASURED BY THERMOMETER) FOR VARIOUS CLASSES OF INSULATION

Class of insulation	Maximum temperature-rise of windings and adjacent cores (above 40 deg. C. ambient)	Maximum temperature of windings and adjacent cores
	Deg. C.	Deg. C.
A	55	95
E	65	105
B	75	115
F	95	135
H	115	155

the radial air gap between rotor or stator; or to deflection of the rotor on to the stator on account of unbalanced electromagnetic pull caused by an open-circuit in the rotor circuit of a slip-ring motor. More often, however, overload is attributable to an external cause such as incorrect lubrication, adjustment, or operation of driven plant; tight glands; tight belts; or incorrect alignment of a direct-coupled motor. It is possible that a motor may be large enough to drive the load, but that the starting torque may be too low to start it satisfactorily. In these circumstances, the remedy may be to employ a motor having a higher starting torque/full torque ratio, although with an auto-transformer starter the difficulty might be overcome by using starting tappings of higher voltage.

PERMISSIBLE TEMPERATURES

Impending trouble with a motor is often indicated by overheating when running. Burning-out can often be avoided by removing the cause of such overheating. It should be realised, however, that many of the newer motors are designed to run safely at quite high temperatures. In case of doubt, therefore, it is wise to measure the actual temperature of the windings (or of cores in contact with the windings) by means of a thermometer. When measuring the temperature of a motor, parts of the bulb not in contact with the surface to be tested should be covered with a piece of felt or other heat insulating material. The temperature of the surrounding air should also be measured. If the ambient temperature of the air does not exceed 40 deg. C., the temperature-rise of the machine may safely range up to the values given in column 2 of Table 4, depending on the class of insulation used. If the air temperature exceeds 40 deg. C., however, the motor temperature should still be limited to the values given in column 3, even if it is necessary to reduce the load. If the class of insulation is not marked on the motor it should be assumed to be class A.

CAUSES OF OVERHEATING

Since a motor takes more than its full-load current during starting, it may overheat on normal load if stopped and started very frequently. In these circumstances the remedy may be to fit a larger motor, or possibly one having a higher starting torque/full-load torque ratio, preferably with a lower starting current/full-load current ratio. Most motors have continuous rating, but one with a short-time rating may overheat if used at its rated load for more than the rated period, without being allowed to cool down.

Overheating may also occur on normal load, and with normal and equal currents in each supply line to the starter, if the starting operation is not completed, or if the terminal connections of the motor are incorrect. Overheating with normal and equal currents, and normal and equal voltages at the motor terminals, may also be due to inadequate ventilation. This condition may arise if the motor is in a hot-air pocket near a roof, or in an unventilated enclosure, or if it is dirty. If a motor overheats because it is in a hot position, it may be advisable to fit one of larger horse-power rating.

A common cause of overheating is mechanical overload, which is indicated if the line currents are equal but excessive, with equal and normal voltages between the phase terminals of the motor.

A motor may overheat on normal horse-power loading if the voltage at the terminals is low, since the current taken to develop the rated horse-power is practically inversely proportional to the voltage. This condition is indicated by low—but equal—voltages between each pair of phase terminals at the motor, with equal—but correspondingly high—currents in each supply line.

Overheating may also result from an open-circuited supply line to a particular motor, in which case the current in the two sound lines will be increased, and there will be no current in the faulty line. A high-resistance contact or connection in one line, or unbalanced single-phase loads, or a supply fault, may result in unequal voltages at the motor and unequal currents in the supply lines, with consequent overheating. It should be noted, however, that the effects may be similar if there is an open-circuit in one line to a distribution point connected to another motor or motors, which are running.

Overheating may also be expected if there is an open-circuit in one phase of star-connected stator windings. In this case, the voltages at the motor terminals will be equal and normal, but there will be zero current in one line. If there is an open-circuit in one phase of delta-connected stator windings, however, the current in two lines

will be equal, and the current in the third line will be higher. Fig. 2 shows the two types of winding. If there is an open-circuit in one phase of star-connected windings the motor will not be self-starting, but with an open-circuit in one phase of delta-connected windings the motor may start when switched on.

A short-circuit or an earth fault in a motor will also cause overheating. If the measured resistance between pairs of phase terminals at the motor is unequal, a short-circuit or open-circuit is the cause.

An open-circuit in the rotor circuit of a slip-ring motor should be suspected if there is a periodic swing of the needle of an ammeter connected in the stator circuit, or if there is zero current in one cable between the slip-ring brushes and the rotor starter.

Lancashire Dynamo Transistorized Photo-electric Equipment

When required for counting purposes, the series TPU.1 transistorized photo-electric equipment introduced recently by Lancashire Dynamo Electronic Products, Ltd., Rugeley, Staffs. (a member-firm of the Metal Industries Group), is supplied with a series F.43 electro-magnetic counter, as seen in the accompanying figure. This counter unit is energized directly from a transistor switching circuit, at speeds up to 1,500 operations per min., and incorporates six number wheels, to indicate a total of 999,999. Provision is made for manually re-setting the wheels. The equipment can also be employed for applications where switching is required, and for this purpose, the photo-electric unit is supplied with an integral relay, which has a pair of normally-open and a pair of normally-closed contacts, rated at 3 amp. at 230 volts a.c. Switching rates up to 300 per min. can be obtained when this arrangement is used.

Lancashire Dynamo transistorized photo-electric equipment is here seen arranged for counting applications

The equipment is suitable for connection to a.c. electrical supplies at 100/115 or 200/250 volts, 50 cycles, and the photo-electric unit is energized by a remote, 8-watt light source unit, which may be set at distances up to 25 ft. Power supply for this unit is taken from the photo-electric unit.

Use of a Hydraulic Crane on a 6-ton Lorry for Handling Machine Tools

To facilitate the delivery of machine tools to customers not equipped with adequate lifting appliances, Adcock & Shipley, Ltd., Ash Street, Leicester, have mounted a Hiab 2-ton hydraulic crane on a 6-ton Bedford lorry, as shown in the accompanying illustration. This crane is arranged for hydraulic movement of the articulated arm, also for swivelling. To prevent the lorry from overturning when the machine tool being off-loaded is swung over the side, a hydraulic jack ram is provided on each side, just behind the cab.

Unloading a Bridgeport milling machine built by Adcock & Shipley, Ltd., from a 6-ton lorry equipped with a Hiab 2-ton hydraulic crane

This arrangement has obviated the need for special low-loading vehicles and the use of shear legs, and permits quicker turn-round of the lorry, with consequent improvement in transport efficiency.

Mechanism for Instantaneous Opposed Reciprocation of Parallel Shafts

By ARTHUR MEDER

THE MECHANISM described in this article was developed for use on a certain type of textile machine, to replace a cam-operated device which was subject to heavy wear, but it may have other applications. The machine provides for twisting yarn as it is delivered from a spinning machine, and for winding it on to a core piece in a zig-zag form, to produce a spool of approximately 5 in. diameter. It will be appreciated that the yarn requires to be fed from one end of the core to the other, to produce the zig-zag form, and that reversal of direction at each end of the core must be virtually instantaneous. Slight pauses at the ends of the core result in an accumulative build-up of yarn, in the form of a collar at each end, which is not acceptable. Build-ups of this type were experienced with the original mechanism, as a result of wear on a drum cam which was responsible for reversing the direction of feed of the yarn.

Sectional views of the mechanism which was finally adopted are shown in Fig. 1 and attention is drawn first to that on the line Z-Z. The chain sprocket *A* is pinned to the shaft which originally carried the drum cam, and drive is transmitted, by way of a roller chain, to the sprocket *B*. This sprocket is pinned to one end of a short shaft, on the other end of which there is a bevel gear *C*, which meshes with another bevel secured to

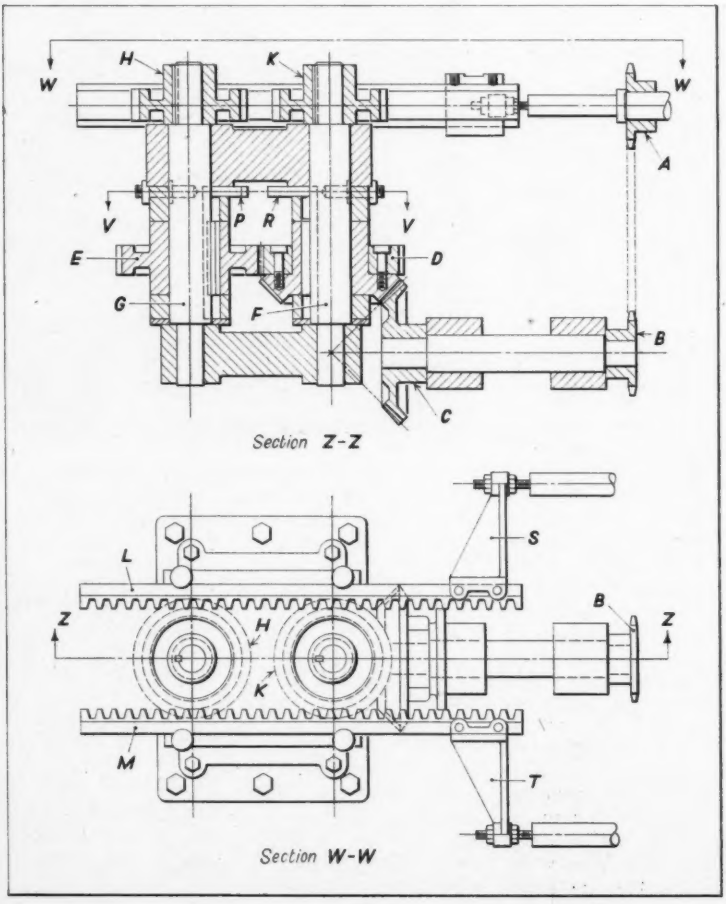


Fig. 1. Sectional views of a mechanism for providing simultaneous and opposite reciprocation of two parallel racks, with virtually instantaneous reversal

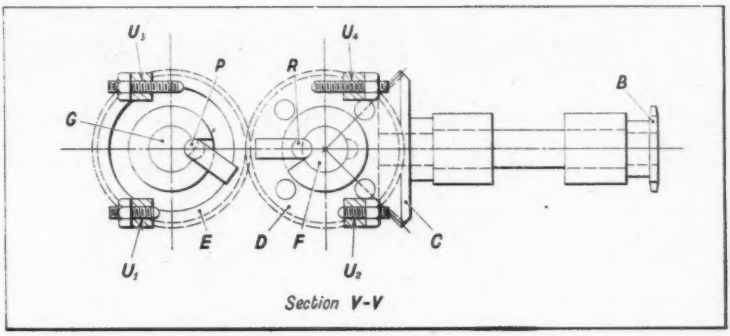


Fig. 2. This sectional view shows the special rolling keys and their associated stop screws

one side of the spur gear *D*. The bevel and spur gear assembly is coupled to the shaft *F* by means of a special key, the design of which will be described later, and a similar type of key is used in conjunction with the spur gear *E* and the shaft *G*.

The shafts *F* and *G* are parallel, and it will be noted that the gears *D* and *E* are continuously in mesh. At the end of each shaft, there is a pinion, as at *H* and *K*, and these pinions are in constant mesh with two parallel racks that can clearly be seen in the sectional view on the line W-W, where they are indicated at *L* and *M*. Referring now to Fig. 2, which is a section on the line V-V, Fig. 1, the gears *D* and *E* are clearly seen, also the special keys *P* and *R*, which are of circular cross-section. Each key has a portion of its length milled away, down to the centre line, and the mating keyways in the gears *D* and *E*, and the shafts *F* and *G* are of circular cross-section, to suit the keys.

At one end of each key there is a turned-up portion, which serves as a short lever, and it will be noted that the key *P* has been turned through a small angle—about its longitudinal centre line—so that it provides a positive drive between the gear *E* and the shaft *G*. The other key, however, is set so that the bevel to which the gear *D* is attached can rotate freely on the shaft *F*. Assuming that the gear *D* is rotating in an anti-clockwise direction as viewed in Fig. 2, the bevel gear will turn freely on the shaft *F* but the gear *D* will transmit drive to the gear *E* in a clockwise direction.

As a result, the pinion *H*, Fig. 1, will rotate in the same direction, and the rack *L* will be moved to the right, and the rack *M* to the left. At the right-hand ends of these racks there are brackets, as at *S* and *T*, which hold shafts whereby the yarn is traversed from one end to the other of the winding core. The movements of the racks as described, however, will cause the pinion *K* to be turned in a clockwise direction, likewise the shaft *F* within the bevel gear attached to the spur gear *D*.

The gear *E*, Fig. 2, continues to rotate clockwise until the lever end of the key *P* strikes the stop screw U_1, which turns the key slightly so that it is no longer in engagement with the gear. At the same time, the lever end of the key *R* strikes the stop screw U_4, thereby turning the key and engaging the drive between the gear *D* and the shaft *F*. Drive is thus transmitted to the pinion *K*, in an anti-clockwise direction, to move the rack *L* to the left, and the rack *M* to the right. The stops U_3 and U_2 serve to reset the keys *P* and *R*, and reverse the motion once more.

With this mechanism, therefore, continuous rotation of the drive sprocket *A*, in the same direction, produces simultaneous and opposite reciprocation of the brackets *S* and *T*, and with careful adjustment of the stop screws U_1 to U_4, virtually instantaneous reversal can be obtained.

METHOD OF HANDLING EPOXY TOOLING RESIN. To facilitate the transfer of epoxy tooling resin from shipping containers to the tanks of dispensing units whereby hardener is automatically added in the correct proportion, a simple expedient has been adopted in the Plastics Tooling Department at the works of The Martin Co., Baltimore, 3, Maryland, U.S.A. The dispenser tank has a capacity of 15 gal. and the opening at the top has a diameter which is ½ in. larger than that of a 10-gal. shipping container.

A perforated pipe, sealed at the lower end, projects upwards from the centre of the base, and supports a cruciform platform at a convenient height within the tank. The upper end of the pipe, which extends for about 2 in. above the platform, is cut at an angle so that it presents a sharp edge. To charge the tank, a shipping container is dropped in, the bottom being automatically pierced so that the resin flows out. The container is left in position, the space between it and the tank opening being closed by a circular seal cut from a flexible plastics board. Contamination is thus prevented.

Reylovolt Low-voltage Transformers

In the illustration are shown three type C 50 Reylovolt low-voltage transformers, which are now being made by the Donovan Electrical Co., Granville Street, Birmingham. These units are of 50, 100 and 250 volt-amp. rating, and were originally produced by Reyrolle, Ltd. The latter company still make units of 500 and 750 volt-amp. rating, and the complete range is marketed by Donovan Electrical Co., Ltd.

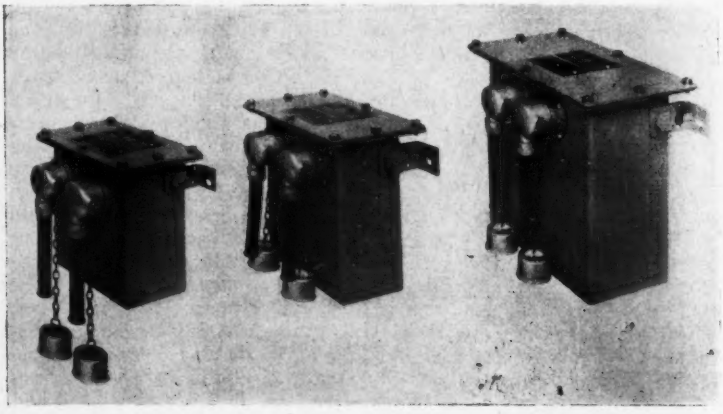
These transformers are intended for use in situations where the use of medium-voltage, portable electrical equipment might be dangerous—for example, in repair shops, boiler houses, and garages. The primary windings can be arranged to suit voltages up to 550, but the standard transformation ratios are 200/250 volts primary to 25 or 12 volts, single-phase, 50-cycle secondary. Tappings in the primary winding provide for inputs of 200/210, 220/230 and 240/250 volts, and the 25- or 12-volt output is obtained by means of change-over links. An earthed barrier between the primary and secondary windings eliminates the possibility of shock to the user. One end of the secondary is also available for earthing on transformers with outputs of 12, 25 and 50 volts.

All transformers with outputs of less than 110 volts are built to B.S. 794/1938, but this specification no longer applies to units for higher outputs. Transformers with 110-volts output can be either earthed at one end or at the mid-point of the secondary windings.

Reylovolt transformers are of the oil-immersed type, in rust-proofed steel enclosures, arranged for wall fixing, and weatherproof (as shown) or dust-proof enclosures can be supplied. Two Reyrolle 2-pole, 5-amp. plugs and sockets are provided, except on the 750 volt-amp. size, which has no secondary plugs and sockets. For the secondary output on all other units, keys are fitted to the plugs and mating slots in the sockets, so that the secondary plug for one voltage cannot be inserted in the socket of a higher-voltage unit.

SONOTEK METHOD OF FLAME DETECTION. Elcontrol, Ltd., Wilbury Way, Hitchin, announce that their research department is developing a method of flame detection based on the discovery that flame envelopes of all types serve as mirrors for the reflection of sound waves. It is believed that such reflection results from a difference in the density of the flame and that of the surrounding gas. Sound waves of high or even ultrasonic-frequency can be projected to detect whether a flame is present or not, and devices for operation by transmission or reflection are being developed.

Such a device, it is stated, is unaffected by oil and other mists, and any reflections from solid surfaces are ignored because the final relay circuit responds only to modulation of the carrier. Even the "steadiest" flame gives a considerable amount of flicker, whereas a solid reflecting surface gives none. In addition, the device is insensitive to radiation, electric sparks, and noise from any source. So far as is known, the phenomenon of reflection of sound waves from a flame envelope has not previously been noted, and it is thought that the discovery represents a basically new contribution in the field of flame detection. All aspects of this detection system are the subject of patent applications, and the possibilities of the new devices in many fields are being investigated.



Units from the range of Reylovolt type C 50 low-voltage transformers, which are now being made by Donovan Electrical Co., Ltd.

Mechanized Heat-treatment Installation for Transmission Parts

By HERBERT CHASE, M.E.

UNTIL RECENTLY, the transmission department of the Buick Motor Division of General Motors, at Flint, Mich., U.S.A., depended upon other sections of the works for heat treatment of transmission components. This arrangement involved extra handling, and as the other sections needed the full capacity of the available heat-treatment equipment, facilities have been provided in a new building for handling all transmission components.

Many small transmission parts are delivered to the heat treatment building on chain conveyors, but the bulk of the work is transported in boxes or on stillages, and is returned to the shops in the same manner. The aim has been to employ conveyors where they are most convenient and economical, but to ensure that the handling and heat-treatment facilities are sufficiently flexible to enable changing conditions to be met.

Most of the furnaces in the new building, and much of the remaining heat-treatment equipment, are entirely new, and at present there is some excess capacity which is employed for engine parts. The layout of the new building and the equipment were carefully studied in relation to the requirements of the work to be undertaken. Provision has been made, in many instances, for mechanical handling and processing, and comfortable working conditions and accessibility for servicing, contribute to efficiency of operation.

Gas fuel is employed almost exclusively, on account of economy, convenience and cleanliness, and no fuel storage is therefore required. All furnaces are on the ground floor, and there is a minimum of overhead piping because most of the auxiliary equipment is installed in a basement. This arrangement also facilitates furnace and other maintenance work and has avoided the need for pits around the furnaces. There is ample clear space between the various installations to ensure accessibility, and the bays are high and well ventilated.

Storage tanks for quenching oil are located below a pavement outside the building to reduce fire risk and permit easy refilling from road tankers, and there are pumps for transfer from storage to any of the quenching tanks. Large water tanks are provided in the basement to which water is returned after being cooled in a tower, and high water consumption is thus avoided. Quenching tanks, pumps and heat exchangers are also located in the basement, and part of the installation is shown in Fig. 1.

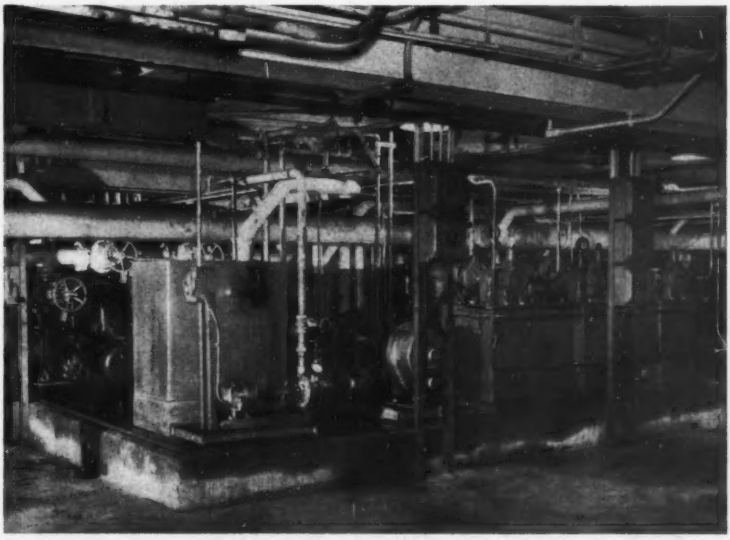


Fig. 1. Part of the installation of pumping and other equipment in the basement below the main floor of the new heat-treatment building. All units are accessible and the arrangement helps to avoid congestion on the floor above

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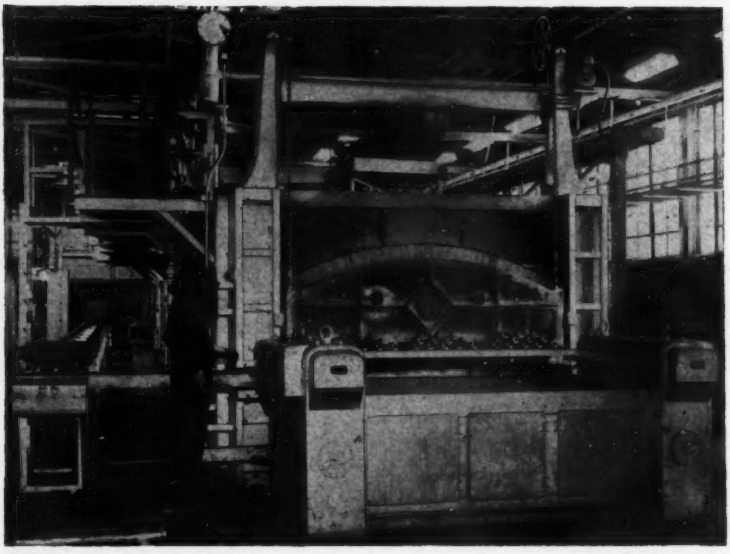

Fig. 2. The loading end of one of the Hagan furnaces employed for annealing steel forgings. Only one man is needed for loading each furnace

A view from the loading end, of one of four gas-fired Hagan annealing furnaces employed for forgings is given in Fig. 2. Trays, returned along a track from the discharge end, are loaded by hand, but other operations, including pushing into and through each furnace, are mechanized.

Work is heated to 1,600 deg. F. in the first zone and is then rapidly air cooled to 1,250 deg. F. Parts remain in these zones for 1½ to 2 hours, and during the remainder of the 7-hour cycle, they are held at 1,250 deg. F., except for a short air cooling period before discharge, which is also mechanized as seen in Fig. 3. All temperatures are controlled automatically.

At the right in Fig. 4 is shown a gas-fired Surface Combustion, radiant tube, rotating retort furnace, employed to restore carbon to the surfaces of parts made from modified SAE 1062 wire of 0·510 in. diameter, which is purchased in coils. This wire is fed through a straightener and into a National upsetter which produces pins with countersunk ends. The pins are passed through a washing machine and thence to a hopper equipped with a Syntron vibrator whereby they are delivered to the retort furnace at the required rate.

This furnace is rotated alternately in opposite directions at speeds which ensure that the pins are fed through intermittently, sufficient time being afforded for heating and for restoring the surface carbon. Carbon is supplied by an atmosphere containing natural gas.

Pins are discharged gradually into a continuously rotating cooling retort, in which an atmosphere of

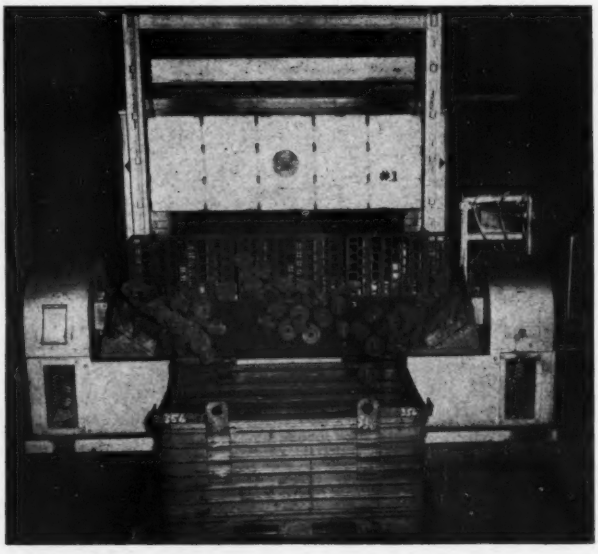

Fig. 3. Annealed forgings are discharged mechanically into boxes as here shown. The trays are shifted to a track at the right for mechanical return to the loading end

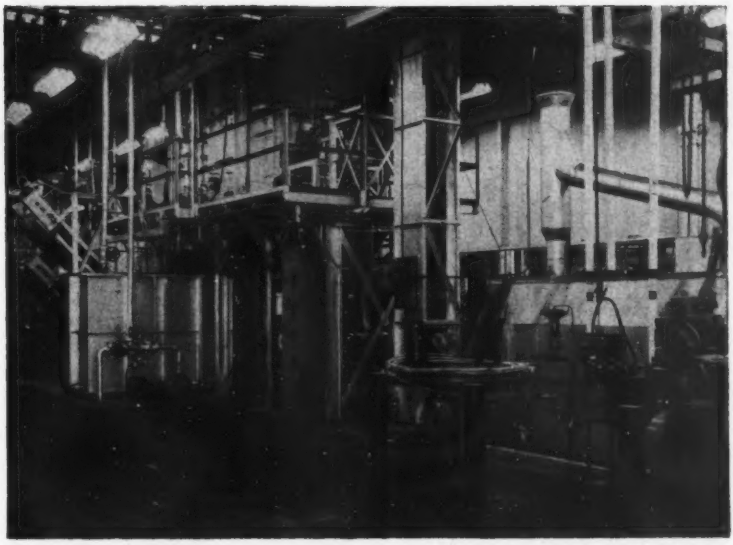

Fig. 4. Equipment for the production and heat-treatment of pins which are cut from wire and upset. The pins are hopper fed to the rotary retort furnace in the background in which the surface carbon content is restored

exothermic gas is maintained, to prevent scaling. When a temperature of 700-800 deg. F. is reached, the parts are dropped into water. Subsequently, the pins are centreless ground, and are then passed through General Electric induction machines in which the central portion of each is heated. They are next dropped into a quenching bath, with the result that the central portions are hardened and the ends left soft.

Numerous small parts which require to be carbo-nitrided are passed through the Surface Combustion furnace shown in Fig. 5, which is gas fired and supplied with an endothermic gas atmosphere. The parts are processed in baskets which are loaded from boxes while on a roller conveyor adjacent to a feeding vestibule. After they have been loaded, the baskets are pushed through the furnace at a rate which ensures the required treatment time.

On leaving the furnace, the baskets enter a quenching tank, and are then returned to the roller conveyor where they are emptied manually into boxes and refilled. All handling is mechanized, apart from loading and unloading of the baskets.

Most of the generators for furnace atmospheres are located in two batteries on the main floor, the gas being discharged into a common manifold from which it is drawn off to the various furnaces.

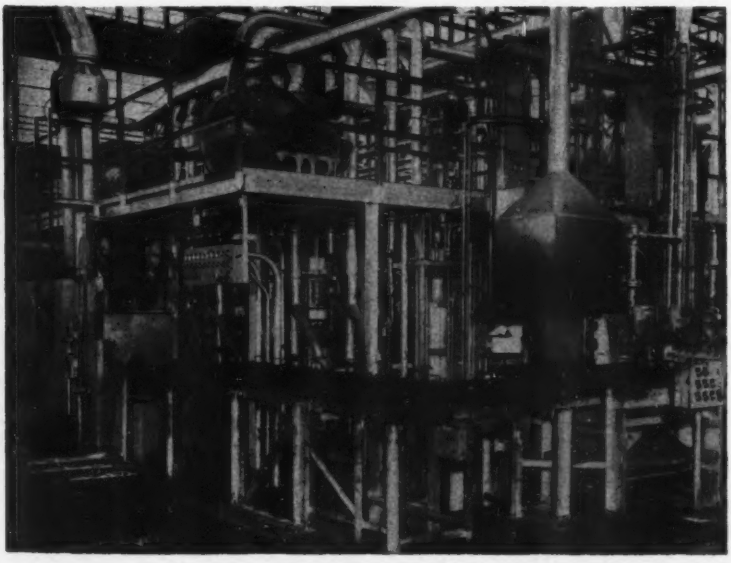

Fig. 5. Surface Combustion continuous carbo-nitriding furnace arranged for mechanical handling of baskets which are loaded and unloaded by hand

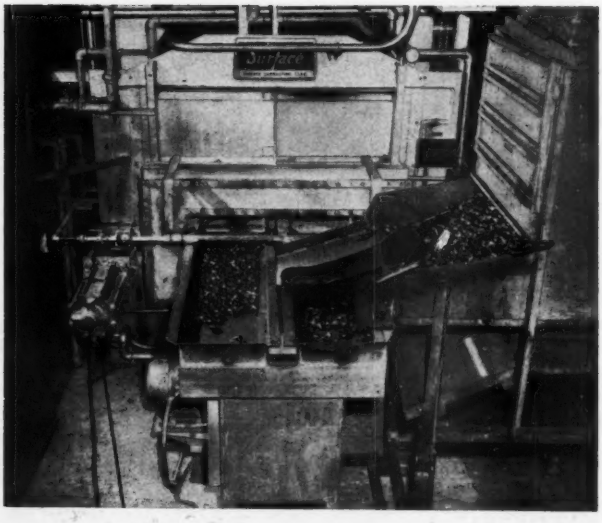

Fig. 6. In this fully mechanized Surface Combustion furnace, parts from the bin at the right are fed by shakers, at a set rate, on to a continuous belt which carries them through a clean atmosphere and discharges them into an oil quenching bath. After this treatment, brittleness is reduced, but hardness is retained

In another gas fired Surface Combustion furnace, supplied with an endothermic atmosphere, pearlitic malleable iron rocker arms (for Buick engines which are built in an adjacent plant) are heat-treated on a continuous belt, which is fed by shakers from a bin, as shown in Fig. 6.

After the parts have been heated to 1,525 deg. F., the belt discharges them into a hot oil quenching bath whereby distortion is minimized. An exothermic atmosphere is maintained over the quenching bath to prevent the oil from breaking down. In the bath, the parts drop on to a conveyor which elevates them to a washing machine, and they then drop on to another conveyor and are advanced on a belt through a furnace maintained at a temperature of 400 deg. F. This treatment reduces brittleness, yet leaves the castings hard.

For heat-treating many steel gears, which are required in large quantities, two Surface Combustion continuous furnaces with hot oil quenching baths are employed, and mechanized loading and unloading have enabled labour requirements to be reduced. The cycle includes heating, quenching in hot oil to avoid distortion, washing, and tempering. Batches of work reach the furnaces, and are removed after the cycle, on conveyors. Only finish grinding and honing of the teeth are required after heat-treatment.

HEAT-TREATING SMALL PINIONS

Small pinions are carbo-nitrided in three batch type Dow furnaces. For this treatment, the parts are delivered in baskets from a highly mechanized production line, and are reloaded at the furnaces into alloy heat-treatment baskets.

After they have been loaded, these baskets are pushed into a vestibule by hand. When carbo-nitriding has been completed, the load is returned to the vestibule, and the baskets are lowered by an elevator into the hot oil quench. The oil is positively circulated to ensure that the gears are cooled rapidly and uniformly. Here again, distortion is so slight that, although very close dimensional limits are specified, only finish grinding and honing of teeth are required prior to final inspection, which includes a noise test.

Only a part of the equipment of the new plant has been mentioned here. In all, some 250 different components are heat-treated on more or less regular schedules.

PRESSEES DIE LUBRICANTS.—The range of industrial oils which is produced by Isaac Bentley & Co., Ltd., Trafford Park, Manchester, 17, has been extended by the introduction of new die lubricants that are being marketed under the name Pressees.

Intended for use in pressing operations on a variety of non-ferrous and ferrous metals, including stainless steel, Pressees FX lubricant is water soluble. It need not be washed from workpieces which are subsequently to be welded, and is readily removable if the pressed components are to be painted.

In addition, there is a type A.C. extreme-pressure die lubricant for deep-drawing work in mild steel, a type S.D. for use in producing shallow drawn and blanked components, a type D.X. for tin plate and non-ferrous materials, and an S.S. grade for deep-drawing stainless steel parts. There is also an oil for use on piercing tools, and standard and heavy grade lubricants for general motor-vehicle pressings and skin pressings of a difficult nature.

Seam-welding Stainless Steel

By W. A. OWCZARSKI* and R. E. BEACH*

IT WAS REQUIRED to fabricate air-tight containers from 0·003 in. AISI type 304 stainless-steel at the Knolls Atomic Power Laboratory, which is operated by the General Electric Co., U.S.A., for the United States Atomic Energy Commission. For each container it was necessary to weld several lap-seam joints, and no equipment was available in the laboratory which was suitable for this delicate operation. Moreover, the cost of a new installation would have been far too high in proportion to the small number of components to be made.

* Knolls Atomic Power Laboratory, Schenectady, N.Y., U.S.A.

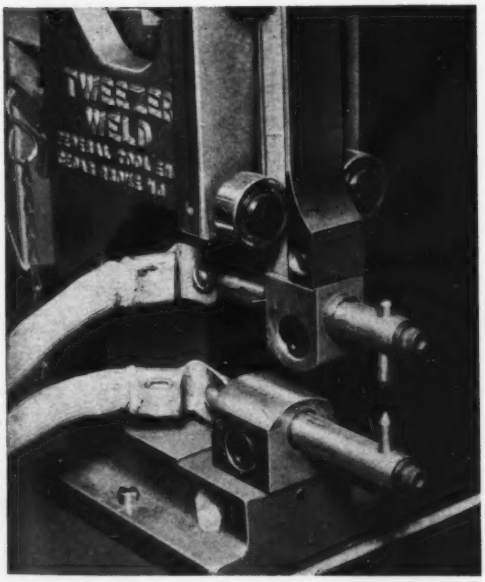

Fig. 1. The Tweezer Weld bench-type spot-welding machine built by Federal Tool Engineering Co., which was adapted for seam-welding 0·003-in. thick AISI type 304 stainless-steel foil

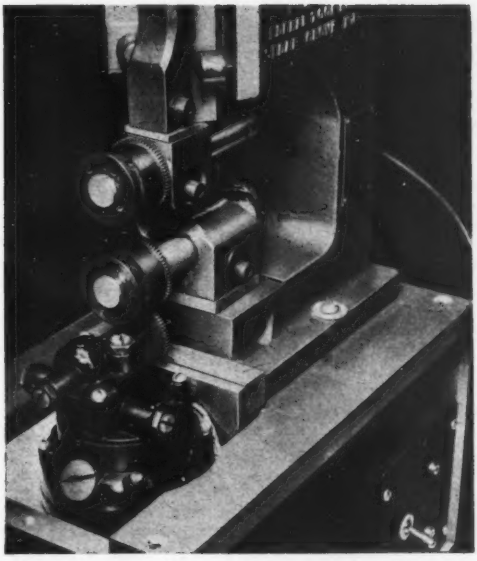

Fig. 2. A view showing the spot welder after conversion for seam welding

The problem was solved in a relatively simple manner, and at surprisingly low cost, by modifying a bench-type spot welder head so that it would operate as a seam welder. To retain the usefulness of the equipment for spot welding, all modifications were carried out without machining the original head. This head, which is shown in Fig. 1, is pedal-operated and a built-in spring mechanism enables a maximum electrode force of 100 lb. to be exerted, adjustments being made by means of a sliding fulcrum in the spring system.

To convert the machine for seam welding, the entire head was attached to a sturdy aluminium frame base, as seen in Fig. 2, which also houses the driving motor for the electrode wheels. A motor is employed to which a gearbox is attached for speed reduction. The speed of the motor is adjustable by varying the voltage input, and for this purpose a standard electronic direct-current power supply is employed which can be regulated to feed from 10 to 120 volts to the motor windings. A range of electrode wheel speeds from 1 to 5 r.p.m., is thus obtainable.

The electrode arms of the spot welder were replaced by similar shafts machined from RWMA Class II copper alloy. These arms were designed as axles to accommodate opposed seam-welding electrode wheels of 1½ in. diameter. The wheels,

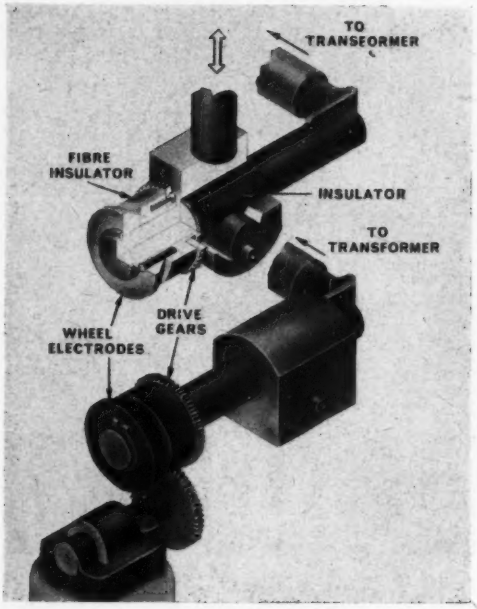

Fig. 3. Cut-away perspective view of the seam-welding electrode wheels and driving gears

seen in Fig. 3, were made with a $\frac{1}{16}$-in. wide face, which was machined to a 2-in. radius camber, to assist in maintaining uniform pressure during welding.

These wheels are a slip fit on the shafts, and as the load is fairly light, they can turn freely. To reduce friction, a thin film of high-conductivity grease was applied to the shaft surfaces. An insulated driving gear was also mounted on each shaft. These gears provide a positive drive to both wheels, which is of critical importance for light-gauge work. If the two electrode wheels do not rotate at the same speed the work will curl, unless it is restrained by a rigid fixture. Apart from the fact that such a fixture may be expensive, it may cause high shear forces at the weld line.

With the wheels and rotation speeds available, the range of surface-welding speeds obtainable with this equipment is 5 to 23 in. per min., which is sufficiently wide for the material thicknesses to be welded.

The welding current and sequence timing for the operation are provided by a transformer and electronic unit, from another seam welder. By merely running copper bus-bars to the upper and lower platens of a large seam welder, the necessary power for welding was readily obtained. The control panel of this machine incorporates a synchronous timer which is accurate to one cycle.

In addition to the 0·003-in. stainless-steel, other materials, such as carbon steel, brass, and platinum, were successfully seam-welded in thicknesses ranging from 0·002 to 0·006 in.

If high quality results are to be obtained when welding the 0·003-in. thick stainless steel, the surfaces must be carefully prepared. The Type 304 stainless steel employed had a fine, cold-rolled finish. Prior to welding, the surface was cleaned by rinsing in acetone, thoroughly washing in detergent, rinsing again in water, and drying. On other materials there may be oxides or other tenacious surface contaminants, and acid-etching is then necessary if the optimum results are to be obtained.

To check weld quality, two methods were employed, namely sectioning for microscopic examination, and the "pillow test." The latter test is a simple method of ascertaining whether a weld is leak-tight. For this test, two 2-in. squares are welded together on all sides to form an enclosure. Before the fourth side is welded, one or two match heads are placed between the sheets, and after this side has been closed, the test piece is heated carefully to ignite the heads. A considerable volume of gas is thus released and if the welded joints are sound, the test piece is inflated as seen in Fig. 4. If there are any small leaks from the seams, their presence is revealed by a pungent odour.

The microscopic examination of seam welds produced with the equipment described has shown

Fig. 4. Match heads, sealed within a welded test piece, ignite when heated and cause inflation

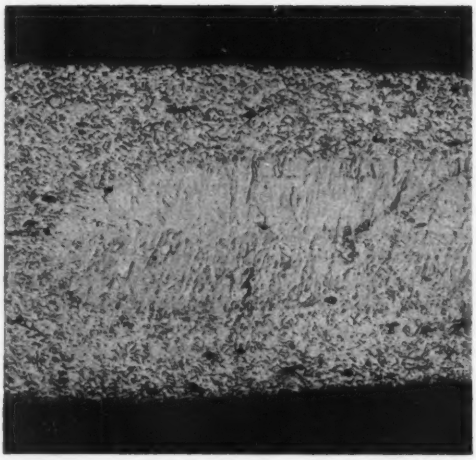

Fig. 5. Photomicrograph of a longitudinal section of a seam weld in 0·003-in. 304 stainless steel, at 250× magnification

them to be uniformly sound. A typical cross-section is reproduced in Fig. 5, and it will be noted that the weld nugget accounts for about 50 per cent of the thickness of the joint.

Books Received

STATISTICAL PROCESSES AND RELIABILITY ENGINEERING. By D. N. Chorafas. D. Van Nostrand Co., Ltd., 358 Kensington High Street, London, W.14. 438 pp. [Price 96s. net.]

Concerned with the theory and application of mathematical statistics, this book is arranged to meet the particular requirements of reliability engineers. It presents an integrated approach to stochastic processes and to their application as a means for prediction and control.

PRINCIPLES OF MANUFACTURING MATERIALS AND PROCESSES. By J. S. Campbell. McGraw-Hill Publishing Co., Ltd., 95 Farringdon Street, London, E.C.4. 674 pp. [Price 72s. net.]

In this comprehensive book on manufacturing methods, the author covers measuring and gauging, heat treatment, casting by various methods, plastic working of metals, welding, brazing and soldering, and metal machining on conventional machine tools. Some reference is made to plastics moulding and forming, also to powder metallurgy.

BRITISH AND FOREIGN SPECIFICATIONS FOR STEEL CASTINGS—PART 2. The British Steel Castings Research Association, East Bank Road, Sheffield, 2. 42 pp. [Price 40s. postage paid.]

Part 1 of this publication was issued in December, 1929, and is said to have been a "best-seller." Part 2 (like Part 1) forms a "guide-book" for the identification of oversea standard specifications for steel castings and their comparison with British Standards. It analyses the specifications of Australia, Canada, Denmark, India, Japan, New Zealand, South Africa and the U.S.S.R. Among the countries covered by the two parts together are all those that issue national specifications for steel castings in the Commonwealth, the Common Market, and the European Free Trade Association.

SAWING AND PLANING. By A. H. Haycock. The Technical Press, Ltd., 112 Westbourne Grove, London, W.2. [Price 15s. net.]

Sawing and planing are the two principal processes in the preparation of timber. To perform them satisfactorily requires both practical care and a degree of specialized knowledge, as emphasized by the author of this book. Circular rip, circular cross-cutting, dimension, and narrow band saws are described, also such machines as the straight-line edger, the multiple edger, the pendulum saw, and the cross cutter. The planing section covers surfacing, thicknessing, and moulding, and types of cutter and adjustment. Throughout, a considerable amount of information is included on tool sharpening, setting, and mounting. The final chapter is devoted to tungsten-carbide tools.

TRADING OPPORTUNITIES IN WEST GERMANY. Export Council for Europe, 21 Tothill Street, London, S.W.1. 51 pp. [Price 5s.]

This booklet, which is the second report on the subject issued by the Export Council for Europe, contains the principal findings and recommendations of an 8-man team drawn from members of the Council, and led by Sir William McFadzean, the chairman, which visited the chief industrial centres of West Germany in May of this year. Illustrative statistics, not previously published, are also included on different products. It is stated that British exports to West Germany have trebled since 1955, and doubled since 1958, and—including re-exports—are now running at the rate of about £190 million per annum. This figure, however, still represents less than 5 per cent of Germany's current imports.

MECHANICAL MEASUREMENTS. By T. G. Beckwith and N. Lewis Buck. The Addison-Wesley Publishing Co., Ltd., Reading, Massachusetts, U.S.A., and 10-15 Chitty Street, London, W.1. 559 pp. [Price 66s. 0d. net.]

The detection and measurement of physical quantities have been considerably facilitated by the use of electronic devices, by new discoveries in connection with physical phenomena, and by the development of materials highly sensitive to various stimuli. This book, which provides a general but fairly thorough treatment of modern techniques, is divided into two parts. The first is concerned with basic standards and accuracy of measurement, basic detector-transducer elements, intermediate modifying systems, and terminating devices and methods. In the second part are described various types of applied measurement such as counting, timing, and the determination of dimensions, strain, force, torque, pressure, flow, vibration, and acceleration. Other matters discussed include shock testing, the applications of radioactive isotopes, and the plane stress problem.

The book should be of considerable assistance to research workers and development engineers.

NEWS OF THE INDUSTRY

Lincolnshire

CLAYTON DEWANDRE CO., LTD., Titanic Works, Lincoln, who are leading producers of vacuum, air pressure and hydraulically-operated braking equipment and heating and demisting equipment for the commercial vehicle manufacturing industry, inform us that they are experiencing an exceptionally heavy demand for their various products.

A certain amount of re-organization has recently been undertaken in the two factories at Lincoln, and in this connection a new department has been established at the Titanic Works for seam-welding, induction brazing, and stud-welding. Equipment installed in this department includes a Rockweld-Autopak submerged-arc welding machine, which is employed for seam welding Air-Pak servo reservoir castings; a 25-kW. Delapena induction brazing machine equipped with a 2-station work-head, which provides for brazing a pipe, a bush, and a screw component into a Hydrovac servo unit in one operation, the stations being arranged to function alternately on a 28-sec. cycle; and two 300-kVA. Sciaky projection welding machines.

At the Boultham works the company manufactures compressors and exhauster units and it was noted that under the re-organization scheme, new machine tools and equipment which have been installed include an OK 250, single-spindle and an L type 2-spindle Alfing fine borer; a Burr 2-spindle fine borer; a Giddings & Lewis-Fraser M.C.2 double-head ending and centring machine; a Churchill-Redman automatic multi-tool profiling and a Churchill-Fay multi-tool lathe; an LA and L.6 grinding machine by Newall; a Duplex, a No. 2 vertical and two horizontal milling machines, and a No. 2 tool and cutter grinder by Cincinnati; a No. 1 24-spindle vertical, a No. 1 8-spindle vertical, a No. 1 24-spindle horizontal drilling machine, and a No. 0 twin head vertical boring machine by Archdale; also a 2-spindle deep hole drilling machine of the firm's own design incorporating Archdale hydraulically-operated unit heads; a Keighley finish grinder for crank pins; two Heald type 221 twin-head fine borers; a Hi-Ton hydraulically operated press; a Dawson automatic washing machine; two Otto-Muller pitch-controlled tapping machines; a Slack & Parr double-head multi-spindle drilling and tapping machine; two No. 1 and a No. 2 vertical, and a No. 0 horizontal milling machine, also a 36-in. capacity radial drilling machine by Adcock & Shipley; a Nagel V.S.8/35 vertical honing machine; two Ryder No. 6 Verticalautos; a 10/36 American vertical broaching machine; a Mullhead Mk.5 special purpose, circular table, automatic cycle drilling, tapping, boring and reaming machine with 19 spindles; two Wadkin

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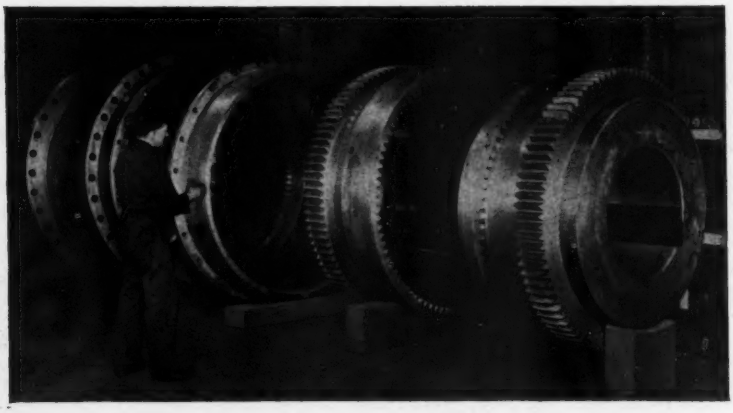
The illustration shows component parts for an internal-gear type flexible coupling designed and made by Crofts (Engineers), Ltd., Bradford. This coupling, which is rated at 45,000 h.p. at 100 r.p.m., is of 73 in. diameter and weighs 11·8 tons. Three such couplings have been supplied for the new Richard Thomas & Baldwins steelworks at Newport, Mon., where they will be employed in the drives for the tilting arrangements for the steel converters



rotary table type milling machines; a No. 7 turret and three 3D.S capstan lathes by Ward; two No. 5 and two No. 3 Huller pitch-controlled tapping machines; 10 multi-spindle drilling machines of various makes; and 9 small single-spindle drilling machines with multiple heads.

ICTA, LTD., Stamp End Works, Waterside South, Lincoln, are at present extremely busy with the production of various cemented carbide tipped tools, and solid and butt-welded high-speed steel lathe and planer tools. There is also a good demand for special tools of all types, including optically profile ground form tools which this company supplies to the individual requirements of many customers.

The latest additions to the plant have included a surface grinder and two tool and cutter grinders by Jones & Shipman, the former being equipped with a Diaform attachment.

CLARKE'S CRANK & FORGE CO., LTD., Lincoln, report that the demand for forged and machined diesel oil engine crankshafts, for both traction and marine applications, is being well maintained, and that they are also extremely busy with other products which include rotors for electrical equipment, marine shafting, and various forgings required for diesel engines. It was noted that the forge is now equipped with hammers and presses ranging up to 1,200 tons capacity.

RUSTON-BUCYRUS, LTD., Lincoln, are at present exporting approximately 50 per cent of their output and the works are busy with the production of the full range of plant, including various types of excavators from ¾ cu. yd. capacity upwards; walking draglines; blast-hole and water well drills; and dragline buckets.

This company has recently opened a new service and spares depot at Galleymead Road, Colnbrook, Bucks. Other sales and service depots are located at Winwick Road, Warrington; Priorswood Road, Taunton; and London Road, Carmyle, Glasgow. In addition, a depot is to be opened in Cardiff later this year.

MARSHALL, SONS & CO., LTD., Britannia Works, Gainsborough, report that the Thermal Engineering Division is now producing a varied range of equipment, including oil-fired package type shell boilers, with capacities from 500 to 20,000 lb. steam per hour, at pressures up to 250 lb. per sq. in., and hot water boilers from 500,000 to 20,000,000 B.Th.U. per hour. These boilers are built under licence from Cleaver-Brooks, Co., Milwaukee, Wisconsin, U.S.A., who were the originators of the packaged principle.

Other products include a range of sea water distillation plant, which is also built in collaboration with Cleaver-Brooks, and pressure vessels. General fabrication work is also undertaken on a contract basis.

AVELING-BARFORD, LTD., Grantham, inform us that the Invicta Works, which now cover an area of 64½ acres, are fully occupied with the production of the range of road rollers, dumpers up to 27 tons capacity, and mechanical graders. To enable a high rate of production to be maintained, a new-

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Examination of a welded pressure vessel for Hunterston power station is here seen in progress with a Pantak 400 KVP mobile X-ray unit. The reactor vessels and steam raising units have been fabricated for the G.E.C.-Simon Carves Group by The Motherwell Bridge & Engineering Co., Ltd., and five X-ray units of 400 KVP and three of 200 kV capacity have been supplied for use in connection with this work by Pantak, Ltd., Vale Road, Windsor, Berks.

plant installation and plant replacement programme is in operation, and the following machine tools and equipment have recently been installed in various departments: —

A high-frequency induction hardening machine for gears, and another for shafts, by Delapena; an Efco-Lindberg Super Cyclone, type 3360.S.C. vertical electric furnace, with a capacity of 33 in. diameter by 60 in. deep, a rating of 120 kW. and a maximum temperature of 950 deg. C.; a Heald type 272 plain internal grinder; a 64.B.M.M. Tarex fully automatic turret lathe arranged for hydraulic copying; a Landis-Maiden M.B. series screwing machine; a No. 7 Preoptive and a No. 9C turret lathe, each with a rear slide arranged for hydraulic copying, and a No. 12.B turret lathe with power cross feed to the hexagon turret, by Alfred Herbert; an Oerlikon-Spiromatic No. 2 spiral bevel gear generating machine; a Sykes gear shaving machine; a V.D.F. type V.3 centre lathe of 20 in. diameter swing capacity over the bed and admitting 39¾ in. between centres; and a Richards P.R.T. type 4-in. spindle horizontal boring and milling machine.

R. SUTCLIFFE.

The South

THE ACCLIM CO., LTD., Rye Road, Hoddesdon, Herts., are now well established in new works to which their entire manufacturing plant was transferred from premises at Walton Road, Hoddesdon. With an area of 7,500 sq. ft., and occupying part of a level site which affords space for later expansion, the new factory buildings are intended solely for the manufacture of high speed steel ground-thread taps and dies in standard and special sizes from 0·030 in. to 6·000 in. diameter, and with Whitworth, American, Unified, and Acme thread forms.

Equipment installed enables all operations required for the production of taps and dies to be performed efficiently, including the preparation of blanks followed by drilling, fluting, thread forming, heat treatment, and inspection. The accompanying illustration, depicting part of the thread grinding bay where machines by Coventry Gauge & Tool Co., Ltd., and Newall Engineering Co., Ltd., are installed, shows a gated belt conveyor which serves to transfer completed taps and dies from a number of work stations to separate delivery bins in the inspection department, seen in the background. Each thread grinding machine is provided with an indicator lamp which can be illuminated if a member of the inspection staff wishes to communicate with the operator. It may be noted that the large tap seen on the conveyor, which was made to special order, is 2 in. diameter by 7 t.p.i. B.S.F.

The company was registered in 1954 and started to manufacture taps and dies two years later. Sales of these tools expanded rapidly at home, and increasing attention was then directed to overseas markets which have been steadily developed, particularly in Canada, the U.S.A., and Europe.

Gated conveyor employed for transferring work from thread grinding machines to the inspection department at the factory of the Acclim Co., Ltd.

W. J. MEDDINGS, LTD., Ipswich Road, Trading Estate, Slough, Bucks., report that their output of machine tools is now higher than ever before, and that exports to the U.S.A. and European countries are gradually increasing. An order was recently placed for special purpose drilling and tapping machines to a value of £25,000 for delivery to a typewriter factory in Portugal.

We were informed that the demand for standard drilling machines is well maintained and orders for special purpose machine tools show an upward trend. An extension to the works which is now in use has brought the total productive floor area to more than 50,000 sq. ft. New machine tools have been installed in the works and a Bullows Nopump spray booth in the finishing section.

Some typical examples from the range of machine tools built by the company are being shown at the Seventh European Machine Tool Exhibition in Brussels.

PAYNE PRODUCTS INTERNATIONAL, LTD., Buckingham Avenue, Trading Estate, Slough, inform us that they are experiencing a very satisfactory demand for their Lapmaster lapping machines which are built in a range of six sizes, the largest being provided with a lapping plate which will accept parts up to 33 in. diameter. Many of the Lapmaster machines are exported and it is stated that well-known European manufacturers, including several in the motorcar industry, are among the company's customers. As a service to industry, the lapping of a wide variety of parts made from steel, carbon, ceramic and other materials is undertaken at branch works in Huddersfield and East Kilbride, Glasgow, where there are facilities for finishing surfaces to a flatness of less than one light band, and 2 to 3 micro-inches. In this country, a leading firm engaged in the manufacture of road vehicles has installed 24 Lapmaster machines to enable high finishes to be obtained on water pump impeller seal faces, ends of valve stems, and tappet bases, for example.

PARMALEE (G.B.), LTD., 39 Bedford Avenue, Trading Estate, Slough, who specialize in the design and manufacture of protective goggles, spectacles, eye-shields and face-shields for industrial use are expanding their manufacturing facilities to meet the demand for these products from the home and export markets. There is a growing awareness in many industries, it is reported, of the need for reducing the incidence of eye injuries which occur when operators and others are insufficiently protected. Many improvements have been made in the design of safety eyewear during recent years, and lightweight plastics spectacles have been introduced which may be worn for extended periods without discomfort.

One of the most recent products of the Parmalee organization is the Everyman eye protector which can be adapted for a variety of purposes. These protectors may be fitted with lenses made from clear or tinted durable plastics material which are stated to be unaffected by condensation on account of the improved system of ventilation that is employed.

PUNCTUAL PRECISIONS, LTD., Windsor Parade, Worcester Park, Surrey, are very busy on close-tolerance batch production work for a number of customers. In progress through the shops are several light alloy castings in which accurately located holes of various diameters are to be bored. Radial holes are being machined in flanged, hemispherical lenses, produced from Perspex, and prototype units for car suspension systems and a variety of instrument parts are being produced. Jig boring and jig grinding is undertaken for the trade, and Newall and Moore machines are employed for this work. Jones & Shipman universal and surface-type machines provide for conventional grinding operations. A Colchester lathe and a Bridgeport turret milling machine are to be installed in the near future. F. W. HERRIDGE.

Developments in the Application of Ultrasonic Vibration

(*Continued from page* 591)

possible to direct a beam through a rubber hose or metal tube which follows a curved path, and thence project it within a confined space. Some obvious uses of such equipment include the guarding of presses and other machinery, counting of work-pieces passing along conveyors, and level control in bins and hoppers.

Another property of ultrasonic waves—in common with sound waves—which has only lately been discovered, is that they are reflected by all types of flame envelopes. They thus provide an effective means of detecting the presence or absence of a flame, and it is understood that equipment is now being developed on the basis of this property for operation both by reflection and transmission.

These more recent developments afford further evidence of the wide field of utility of high-frequency, low-amplitude vibrations, and no doubt there are other potential applications which remain to be explored and exploited.

Motor Control Gear Maintenance

A new Code of Practice (C.P.1011) for the maintenance of electric motor control gear has been published by the British Standards Institution under the authority of the Council for Codes of Practice. It provides guidance on those matters which experience has shown to be of major importance in keeping electric motor control gear in efficient working condition. The various statutory regulations with which electrical installations may have to comply are indicated, and such general matters as inspection, observance of manufacturers' instructions, and the analysis of faults are covered.

An important section is concerned with the safety of personnel operating installations, with particular emphasis on such precautions as: isolation before maintenance work is carried out; the use of voltage indicators; special measures to be taken in dealing with oil-immersed equipment; and the maintenance of earthing connections. Notes are included on first-aid and fire extinguishing equipment.

Copies of this Code may be obtained from the British Standards Institution, British Standards House, 2 Park Street, London, W.1. [Price 6s.—postage extra to non-subscribers.]

Industrial Notes

OAKLAND PRESSTOOL CO., LTD. The address of this company is now 14 Claymill Road, Leicester (telephone Leicester 68525).

RAPID MAGNETIC, LTD., Lombard Street, Birmingham, 12, have introduced a unit for incorporation in pipelines, which provides for the removal of small ferrous particles, for example, from oils and machine tool coolants.

CLEVELAND TECHNICAL COLLEGE, Corporation Road, Redcar, have issued a detailed prospectus for 1961-62, giving information on fees, general regulations, and particulars of the numerous courses offered by the various departments.

PYE TELECOMMUNICATIONS, LTD., Cambridge, announce that the Pye 20-line electronic telephone exchange is now in quantity production. It is stated that this private internal exchange has no moving parts and is silent in operation.

B.S.A. TOOLS GROUP, LTD., is the title of a new holding, company which has been formed for the ten companies previously included in the B.S.A. Tools Division. All are subsidiaries of the Birmingham Small Arms Co., Ltd. The address of the new company is Mackadown Lane, Kitts Green, Birmingham, 33.

THE BENJAMIN ELECTRIC, LTD., Brantwood Road, Tottenham, London, N.17, recently opened new Scottish offices at 259 St. Vincent Street, Glasgow, C.2, where a wide range of industrial and commercial lighting fittings, also outdoor fittings and floodlights, will be permanently displayed.

EMI ELECTRONICS, LTD., Hayes, Middlesex, have supplied to the Central Electricity Generating Board, for use in connection with the No. 1 reactor of the nuclear power station at Berkeley, Gloucestershire, hand and clothing monitors and portable contamination monitors to the value of nearly £40,000.

THE PLESSEY CO., LTD., have concluded negotiations for the lease of an additional 50,000 sq. ft. factory at Cheney Manor, Swindon, from the Swindon Corporation. It is expected that this factory, which is close to the other premises occupied by Plessey, will be used for expansion of the company's Industrial Hydraulics Division.

HAWKER SIDDELEY INDUSTRIES LTD., 32 Duke Street, London, S.W.1, have formed a new division, known as Hawker Siddeley Engineering, which will undertake the design and construction of comprehensive engineering schemes, for example, for electrical power, radio telescopes, automatic railway control, automatic warehousing and automated manufacturing plant.

SCHULER PRESSES, LTD., P.O. Box 51, Banner Lane, Tile Hill, Coventry, inform us that a mobile service unit from L. Schuler A.G., is at present visiting this country and calling on users of Schuler presses for service checks of equipment. The service is available free of charge to Schuler customers, and particulars of the itinerary can be obtained from the above address.

CROFTS (ENGINEERS), LTD., announce that extensive modifications have been made to their premises at 36-42 Tanner Street, Bermondsey, London, S.E.1, as a result of which comprehensive stocks are now held at this address in addition to those at Manchester, Birmingham, and Leeds. Apart from the stocking facilities, a showroom has been provided for display of power transmission equipment.

BEDFORD ROCK DRILL COMPONENTS, LTD., is the title of a new company that has been formed to produce fully carburized rods for rock drilling. The plant is now nearing completion, and manufacture will begin shortly on a site adjacent to the main Lion Works, Sheffield 3, of John Bedford & Sons. It is stated that only three other companies in the world—in Denver, U.S.A., Johannesburg, and Canada—undertake the production of these rods.

INVICTA ELECTRODES, LTD., Bilston Lane, Willenhall, South Staffs., are introducing a new range of stainless steel electrodes under the name Supa-Stainway. The first of these electrodes, designated type M, deposits a weld metal containing chromium 18, nickel 8, and molybdenum 2¾ per cent. Advantages claimed include low initial cost, rapid welding, high output of weld metal per electrode, and ease of application.

AMERICAN SOCIETY FOR TESTING MATERIALS, 1916 Race Street, Philadelphia 3, Pa., U.S.A. A complete list of the Society's current publications has been issued, in which particulars are included of some that will shortly be available. The publications cover standards, symposia, charts, indexes, manuals, and proceedings. Brief particulars of contents are included and the titles are conveniently arranged. There is also a subject index to facilitate reference.

PROFIT BY HANDLING! is the theme of a convention which has been organised by the Materials Handling Group of the Institution of Production Engineers in conjunction with the Institute of Materials Handling, and will be held at the Connaught Rooms, London, W.C.2, on November 3 and 4. Details of the programme and forms of registration can be obtained from The Conference Secretary, Institution of Production Engineers, 10 Chesterfield Street, Mayfair, London, W.1.

NET SALES OF PLASTICS MATERIALS of United Kingdom manufacture reached a new record level in the second quarter of 1961 at 158,200 tons. This total was 10,800 tons higher than the previous record figure achieved in the first quarter of 1960. The improvement in sales appears to have been due to higher exports and the replacement of imported by home produced materials. It is estimated the United Kingdom consumption in the second quarter was only slightly higher than a year earlier.

FRY'S DIECASTINGS, LTD., Prince George's Road, London, S.W.19, have acquired the assets and goodwill of the die casting branch of the British Oxygen Co., Ltd., formerly a division of Sparklets, Ltd. The business of Sparklets Works as manufacturers of soda syphons, fire tubes and

other small gas cylinders, inflation apparatus and other products will not be affected, and B.O.C. retains its interests and rights in vacuum die casting patents. Machines and equipment will be transferred to the purchasers' factories during the next few months.

THE ELECTRONIC APPARATUS DIVISION OF ASSOCIATED ELECTRICAL INDUSTRIES, LTD., Crown House, Aldwych, London, W.C.2, in conjunction with the MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD, will stage an exhibition of industrial electronic equipment in the Electrical Industrial Development Centre of the Board at 83 Paradise Street, Liverpool, 1, from October 2 to 6. Only a small section of the range of equipment made by the Division will be shown, but the items will be selected to indicate the variety and scope of the apparatus available for industrial applications.

Personal

MR. ALBERT SPEAK has relinquished his position as chairman and managing director of Coventry Machine Tool Works, Ltd., and John Stirk & Sons, Ltd., Halifax, but will remain on the board of directors.

MR. A. C. STURNEY has been elected to the board of the International Nickel Company (Mond), Ltd., Thames House, Millbank, London, S.W.1. He will be succeeded as general manager of publicity by Mr. L. F. DENARO, who will relinquish his appointment as assistant to the managing director.

MR. FRANK T. BAGNALL, who recently retired from the post of electric furnace melting shop manager at Samuel Fox & Co., Ltd., Sheffield, has made his services available exclusively to Birlec-Efco (Melting) Ltd., Tyburn Road, Erdington, Birmingham, 24, and will assist in the design and operation of all equipment manufactured by Birlec-Efco.

MR. C. E. G. NYE, M.C., has retired from the board of George Cohen Sons & Co., Ltd., Sunbeam Road, London, N.W.10, after 40 years of service with the company. In 1931 he was made manager of the Group publicity department, and he was appointed a special director of George Cohen in 1946. Ten years later, when the holding company was formed, he became a full director of George Cohen Sons & Co., Ltd., the largest subsidiary.

The following new appointments have been announced:—

MR. W. J. AUSTIN-CLARKE as representative in Staffordshire, MR. J. MAYERS as representative in Warwickshire, and MR. O. SUMMERS as representative in Worcestershire, for Stubs Welding, Ltd., Scotland Road, Warrington.

MR. R. F. W. KEAY as an additional member of the board and director of production Engineering, MR. P. D. SCOTT MAXWELL, D.S.C., M.I.Mech.E. as a special director and deputy general manager, Barrow Works, and Mr. J. HAY, A.M.I.Mech.E., A.M.I.Prod.E., as a special director and works manager, Barrow Works, of Vickers-Armstrongs (Engineers), Ltd., Vickers House, Broadway, London, S.W.1.

MACHINERY'S ENQUIRY BUREAU

For many years MACHINERY has provided an enquiry service not only for subscribers and advertisers but for all engineers in need of such information as the names of makers—or their agents—of machines or equipment for performing particular operations, suppliers of various classes of material, firms with facilities for undertaking certain types of work, owners of trade names, and agents for foreign machine builders. If you have such a problem write (MACHINERY, Enquiry Bureau, Clifton House, 83-117 Euston Road, London, N.W.1) or telephone (Euston 8441, 2 lines). This service is, of course, entirely free.

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13/9/61

MANUSCRIPTS FOR BOOKS covering all branches of engineering production will receive careful consideration and should be sent to the Manager, Book Dept., MACHINERY, National House, 21 West Street, Brighton, 1.

CONDITIONS OF SALE AND SUPPLY.—MACHINERY is sold subject to the following conditions:

That it shall not, without the written consent of the publishers first given, be lent, resold, hired out or otherwise disposed of by way of trade except at the full retail price of 1s. 3d. and, that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in an unauthorised cover by way of trade; or affixed to or as part of any publication or advertising literary or pictorial matter whatsoever.

Sir Alfred Herbert Paper

The subject of the 1961 Sir Alfred Herbert paper of the Institution of Production Engineers will be "Finance for Industrial Growth" and the paper will be presented by Mr. D. L. Donne, M.A., executive director of Charterhouse Industrial Development Co., Ltd., in the lecture theatre of The Royal Aeronautical Society, 4 Hamilton Place, London, W.1, on October 17, at 6.30 p.m. Mr. Donne will describe "the problems of finding and providing finance for growing industrial companies and in particular the features that a City institution looks at when considering the provision of additional finance". An open discussion will follow.

The meeting will be open to members and non-members, but admission will be by ticket only. Application should be made to The Secretary, the Institution of Production Engineers, 10 Chesterfield Street, Mayfair, London, W.1.

Zeiss Measuring Instrument Course

Due to circumstances beyond the control of the organisers, the 14th International Instructional Course on Fine Measuring Instruments arranged by Carl Zeiss, Jena, at the Imperial College of Science and Technology (see MACHINERY 99/455—23/8/61), has had to be postponed and will now commence on Monday, September 18.

Corrections

In MACHINERY, 99/407—23/8/61, reference was made to the use of atomizing nozzles for the supply of coolant in the form of mist on New Britain chucking automatics at the Witney, Oxon., factory of S. Smith & Sons (England), Ltd. We have been informed that the name of the manufacturer of these atomizing units was stated incorrectly, and that they are the Jaco No. 1 spray gun made by the Jaco Engineering Co., Ltd., 8 Edwards Road, Erdington, Birmingham, 24.

In the reference to the Graffenstaden AMC.163 floor-type horizontal boring and milling machine, in MACHINERY, 99/472—30/8/61, the country of origin was given incorrectly. We have been asked to point out that this machine is built by Société Alsacienne de Constructions Mècaniques, Graffenstaden, (Bas-Rhin), France, also that the main drive motor is of 45 h.p.

Trade Publications

ROSE BROTHERS (GAINSBOROUGH) LTD., Bearings Division, Gainsborough, Lincs. Leaflet No. 110 describing and illustrating the range of Heim and Rose spherical bearings and spherical rod ends, which were the subject of an article in MACHINERY, 97/1285—7/12/60.

THOMAS W. WARD, LTD., Albion Works, Sheffield. Brochure entitled "Talking About Wards" which extends to 32 pages, and presents an outline of the very wide range of activities covered by the Ward Group. The brochure is lavishly illustrated.

TAYLOR BROS. & CO., LTD., Trafford Park Steel Works, Manchester 17.—Well-illustrated brochure, extending to 16 pp., describing the processes and equipment employed by the company for the production of rings and circular die forgings. The procedure is followed through from the receipt of the cast ingots to the finished products, which can be supplied in the as-rolled or forged condition, rough-machined, or finished-machined.

INDUSTRIAL TRADING CO., LTD., P.O. Box 51, Worcester.—Booklet giving comprehensive technical data in connection with the design, ratings, and application of the wide range of Belleville-type disc-springs made by Christian Bauer, K.G., Germany, for whom the company are sole agents in this country. Ten pull-out tables at the end of the book give the values for deflection under various loads, and stresses on springs of different sizes. The book is specifically intended for the designer who wishes to incorporate disc-springs in machines and mechanisms, and contains all the data he may require.

Scrap Metals

†LONDON.—‡Prices per ton for non-ferrous scrap metals free from iron are as follows:—Clean copper wire, untinned and free from lead and solder, £200; clean heavy copper, untinned and free from lead and solder, £194; copper wire No. 2, £190; clean light copper, £186; braziery copper, £160; gunmetal, £172; brass, mixed, £126; lead, net, £51; zinc, £35; cast aluminium, £95; old rolled aluminium, £96; battery lead, £26; unsweated brass radiators, £100; hollow pewter, £570; black pewter, £450.

MIDLANDS.—Tin has increased substantially in value during the past few days, but has not yet reached a value of £1,000 per ton. This set back may be only temporary, but it has had the effect of slightly curbing prices for tin-bearing materials. Over the past months, this metal has found eager buyers, and although it is still in short supply, its price may provide some interesting variations in the near future. Copper prices have held firm, and a certain amount of concern has been evident due to possible hold-ups over labour disputes in the production areas. In general, the market is a little stronger, with metal changing hands freely.

Indications of metal prices affected by market conditions are as follows:—

Copper.—Demand for the better grades continues to be strong, but buyers of braziery and vat wire grades are still a little cautious on prices.

Brass.—Prices show little change, and all grades have ready outlets.

Gunmetal.—The values of the higher grades of bronzes may be reduced slightly due to the fall in the price of tin, otherwise prices are firm and demand is good.

Lead.—The prospect of an increase in value seemed apparent, but did not materialize and prices have fallen again. If demand increases, the best that can be hoped for is a possible rise of £1 to £2 per ton.

Aluminium.—Very dull market conditions continue without an improvement in prices for any grade.

Zinc.—Demand fairly good, with hardly any change in prices.

Whitemetal.—All types of scrap will ease in value with the fall in the price of tin.

† George Cohen, Sons & Co., Ltd., 600 Wood Lane, London, W.12.
‡ Subject to market fluctuations.

Plant Engineering Refresher Course

The latest in the series of comprehensive refresher courses for works and plant engineers, arranged by the Institution of Plant Engineers, is to be held at the Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow, C.2, commencing November 1. Sponsored by Sir Andrew McCance, D.Sc., Ll.D., F.R.S., chairman of Colvilles, Ltd., and of the Board of Governors of the Royal College of Science and Technology, Glasgow, the course comprises 18 weekly lectures, which cover a wide range of subjects. The course has been designed to encourage the most effective use of existing knowledge and to promote the application of modern techniques in works-engineering practice over a broad field, and is intended to help works and plant engineers make the fullest contribution to the increase of productivity. It may be of interest to point out that a similar course held in Glasgow in 1953 was attended by 405 engineers from industrial plants with a 50-mile radius of the city.

The fee for the course is four guineas, and copies of the syllabus and full details may be obtained from the secretary to the Refresher Course, 39 Elmbank Crescent, Glasgow, C.2.

Machine Tool Share Market

Stock markets were very quiet during the period under review, but steady to firm conditions were maintained in most sections. The gilt-edged market had sustained small-investment support, which led to improvements in values among British Government stocks and similar issues.

Interest in the commercial and industrial sections remained moderate and selective, and share prices accordingly moved within narrow limits. Good features were not lacking, however, and some gains were shown on balance.

Among machine tool issues British Oxygen advanced 6d. to 18s. 6d.; Broom & Wade 1s. 9d. to 26s. 6d.; Chas. Churchill 6d. to 9s. 4½d.; Coventry Gauge & Tool 3d. to 28s. 4½d.; A. A. Jones & Shipman 1s. to 25s. 6d.; Samuel Osborn 3d. to 47s. 9d.; and Ambrose Shardlow 7½d. to 56s. 10½d.

On the other hand Edgar Allen lost 1s. at 33s. 6d.; Birmingham Small Arms 1s. at 21s.; Brooke Tool 7½d. at 8s. 3d.; Craven Bros. (Manchester) 1½d. at 8s. 1½d.; John Harper 4½d. at 6s. 6d.; Alfred Herbert 1s. at 66s. 6d. and John Holroyd "B" 2s. 6d. at 15s.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	1/6xd
Allen (Edgar) & Co., Ltd.	Ord.	£1	33/6
" " "	5% Prf.	£1	13/6*
Arnott & Harrison, Ltd.	Ord.	4/-	10/3
Asquith Machine Tool Corp., Ltd.	Ord.	5/-	9/-
" " "	6% Cum. Prf.	£1	16/6
Birmingham Small Arms Co., Ltd.	Ord.	10/-	21/-
" " "	5% Cum. "A" Prf.	£1	13/-
" " "	6% Cum. "B" Prf.	£1	16/-
" " "	4% 1st Mort. Deb.	Stk.	98½
British Oxygen Co., Ltd.	Ord.	5/-	18/6
" " "	6% Cum. Prf.	£1	18/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	8/3
Broom & Wade, Ltd.	Ord.	5/-	26/6
" "	6% Cum. Prf.	£1	16/6
Brown (David) Corporation, Ltd.	5½% Cum. Prf.	£1	15/-
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/-
Butler Machine Tool Co., Ltd.	Ord.	5/-	15/-
" " "	5% Cum. Prf.	£1	12/6
Churchill (Charles) & Co., Ltd.	Ord.	2/-	9/4½
" " "	6% Cum. Prf.	£1	25/7½‡
Clarkson (Engrs.), Ltd.	Ord.	5/-	6/3
Cohen (George), 600 Group, Ltd.	Ord.	5/-	11/-xd
" " "	4½% Cum. Prf.	£1	11/6xd
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	28/4½
" " "	5% Cum. Red. Prf.	£1	16/3
Craven Bros. (Manchester), Ltd.	Ord.	5/-	8/1½
Elliott (B.) & Co., Ltd.	Ord.	1/-	2/6
" "	4½% Red. Cum. Prf.	£1	12/-
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	10/-
Greenwood & Batley, Ltd.	Ord.	10/-	17/9
Harper (John) & Co., Ltd.	Ord.	5/-	6/6
" " "	4½% Red. Cum. Prf.	£1	11/7½
Herbert (Alfred), Ltd.	Ord.	£1	66/6
Holroyd (John) & Co., Ltd.	"A" Ord.	5/-	20/-
" "	"B" Ord.	5/-	15/-
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	25/6xd
" " "	7% Cum. Prf.	5/-	4/9
Kearney & Trecker-C.V.A., Ltd.	5½% Red. Cum. Prf.	£1	8/9
" " "	Prefd. Ord.	£1	13/9
Kearns (H. W.) & Co., Ltd.	Ord.	5/-	21/3
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	8/9
Macreadys Metal Co., Ltd.	Ord.	5/-	15/-
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/6
Massey (B. & S.), Ltd.	Ord.	5/-	10/6
Newall Engineering Co., Ltd.	Ord.	2/-	7/-
Newman Industries, Ltd.	Ord.	2/-	7/-
" "	6% Prf. Ord.	5/-	5/-
Noble & Lund, Ltd.	Ord.	2/-	5/9
Norton, W. E. (Holdings), Ltd.	Ord.	2/-	8/-
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	47/9
" " "	5½% Cum. Prf.	£1	22/3
Pratt (F.) & Co., Ltd.	Ord.	5/-	16/3
Sanderson Kayser, Ltd.	Ord.	10/-	32/6
" "	6½% Cum. Prf.	£1	16/3
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	8/6
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	56/10½
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	15/1½
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	19/-
" " "	5% Cum. Prf.	£1	13/3
Stedall & Co., Ltd.	Ord.	5/-	7/6
Sykes (W. E.), Ltd.	"B" non-voting Ord.	10/-	25/7½xd
Tap & Die Corporation, Ltd.	Ord.	5/-	15/6xd
" " "	4½% Deb. 1961-1977	Stk.	81½
Wadkin, Ltd.	Ord.	10/-	26/-xd
Ward (Thos. W.), Ltd.	Ord.	£1	72/6
" "	5% Cum. 1st Pref.	£1	13/6
" "	5% Cum. 2nd Pref.	£1	20/-
Willson Lathes, Ltd.	Ord.	1/-	3/-

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. ‡ Birmingham price.

PRICES OF MATERIALS

All prices per ton except where otherwise stated.

Pig Iron* (10 tons or over)

Foundry and Forge No. 3, Class 2

Middlesbrough	£21 17 0
Birmingham	£21 9 3

Phos. Over 0·1 up to 0·4%

Birmingham	£23 5 0
Grangemouth	£23 10 0

Hæmatite

N.E. Coast (made in N.E.)	£23 19 0
Scotland (made in Scotland, zone S.1.)	£24 5 6
Sheffield	£25 9 0
Birmingham	£25 13 0
S. Wales (made in Wales)	£23 19 0

Steel Products*

Medium plates (50 tons and over)	£43 16 6
Mild steel plates, ordinary (50 tons and over)	£40 7 0
Boiler plates (50 tons and over)	£42 17 0
Flat bars, 5 in. wide and under (50 tons or over)	£39 1 0
Round bars, under 3 in. (50 tons or over)	£39 1 0
Billets, rolling quality, soft U.T. (100 tons or over)	£31 15 6

Phosphor Bronze

Ingots (2B8) (A.I.D.) d/d	£320 0 0

Copper

Cash (mean)	£232 12 6
Cold rolled and hot rolled sheets 4 ft. by 2 ft. by 10 SWG	£309 10 0—£309 15 0
Rods, $\frac{3}{16}$in. to $\frac{1}{2}$ in. diam	£326 0 0
Tubes, $1\frac{1}{4}$ in. bore by 10 SWG, ton lots, per lb.	3s. 2½d.
Wire rod, black, hot-rolled ($\frac{1}{2}$- $\frac{15}{16}$in.), English	£248 2 6

Zinc

Refined, minimum 98 per cent purity, current month (mean)	£73 16 3

Brass

Tubes, solid drawn, basis per lb.	1s. 10½d.
Strip 63/37, 6in. by 10 SWG coils, ton lots	£256 10 0—£259 10 0
Rods, $\frac{1}{2}$-3 in. diam. (59 per cent copper)	2s. 0½d.

Yellow Metal

Condenser plates, per ton	£188 0 0
Rods, per lb.	2s. 1½d.

Aluminium

Ingots, min. 99·5 per cent Canadian d/d	£186 0 0

Tinplates

**U.K. Home trade: Cold reduced, f.o.r. makers works (15-50 tons)	£3 6 8
U.K. Export: Hot rolled basis, f.o.r. works port	73s. 6d.—76s. 0d.
Cold reduced basis, f.o.r. works port	73s. 6d.—76s. 0d.

Gunmetal

Ingots, B.S. 1400 L.G.2, delivered	£220 0 0

* Subject to increase of 1 per cent.

**Subject to allowances and extras.

MAKERS' PRICES

Hexagon Steel Bars[1]

Sizes in inches from 1 in. up to 2·21 and 2·41 a/f ex works, 2 tons basis	£42 17 6†
Free cutting black	£46 14 6†

Reeled Steel Bars[1]

Single-reeled, 1½ in. upwards, f.o.t. works (+ usual extra for sizes)	£43 9 0†
Free cutting	£47 7 0†

Precision-ground Mild Steel[2]

1-in. diam ± 0·00025-in. 4-ton lots, per cwt.	124s. 6d.†

Bright Ground Stainless Steel Bars[3]

EN56AM (martensitic, free cutting)	£304 10 0
EN58AM (austenitic free cutting)	£377 10 0

Prices are basic, subject to extras.

High-speed Steel

Black random length bar. All prices basic, per lb., subject to extras:

Molybdenum "66"	6s. 5d.
Molybdenum "46"	6s. 3d.
14 per cent tungsten	6s. 11d.
16 per cent tungsten	7s. 4d.
18 per cent tungsten	7s. 9d.
22 per cent tungsten	9s. 2d.
5 per cent cobalt	10s. 10d.
4·75/5·25 molybdenum + 6·0/6·75 tungsten + 1·75/2·05 vanadium per cent (5-6-2)	6s. 7d.

Precision-ground, High-speed Free-turning Brass Rod[2]

½-in. diam. ±0·00025-in., 2 ton lots, per lb.	2s. 7½d.

Grey Iron Rod

Die Cast[4] in random lengths 18 in. to 26 in. rough machined $\frac{1}{16}$-in. above listed size. Extra for definite lengths. Discounts for orders over £150.

	Per cwt. net. Mark I	Mark III
¾ or ⅞ in.	260s. 3d.	338s. 3d.
1 or 1½ in.	208s. 4d.	267s. 3d.
1¾ to 1¾ in.	146s. 3d.	181s. 7d.
1⅞ to 2 in.	112s. 7d.	132s. 6d.
2⅛ to 3½ in.	97s. 1d.	112s. 9d.
3⅛ to 12 in.	91s. 9d.	105s. 3d.

Continuous Cast

Centreless machined, 10-ft. lengths 1 to 3-in. diam. + 0·010 to 0·020 in., prices as quoted for die cast bar[4]

Centreless ground +0·010 in. (Extra for hardenable alloy iron)[5]	1 or 1⅛ in.	208s. 4d.
	1⅛ to 1⅞ in.	146s. 3d.
	1⅞ to 2 in.	112s. 7d.
Per cwt. net.	2⅛ to 3½ in.	97s. 1d.

Stellite[6]

Welding Rods, plain

¼ in. diam., per lb.	30s. 0d

Toolbits

½ in. sq. × 4 in., each	22s. 3d.

[1] Colvilles, Ltd., Glasgow, and 17 Grosvenor Street, London, W.1. [2]Pratt, Levick & Co., Ltd., Chester. [3] Spartan Steel & Alloys, Ltd., St. Stephens Street, Birmingham, 6. [4] Sheepbridge Alloy Castings, Ltd., Sutton-in-Ashfield. [5]"Flocast," Harold Andrews Sheepbridge, Ltd., Halesowen. [6]Deloro Stellite, Ltd., Swindon Road, Stratton St. Margaret, Swindon.

† Plus 1 per cent.

BASIC PRICES FROM LONDON STOCK[6]

Free Cutting Steel

Bright cold drawn: (Usaspead) over 1 to 2 in.	£59 4 6‡
Lead bearing (Usaled)	£63 11 0‡
Precision ground, 1¾ in.	£84 14 6‡

Bright Drawn

M.S. bars (M.M.C.) over 1½ to 2 in.	£56 10 0‡
Square edge flats (Useflat)	£73 6 6‡
M.S. angles (Usaspead)	£100 6 6‡
Case hardening (EN) (Usacase) over 1½ to 2 in.	£62 10 0‡
M.S. bars (EN3B) (Usamild) over 1½ to 2 in.	£58 16 6‡
Carbon manganese semi-free cutting case hardening (EN202) (Usaspead 202) over 1½ to 2 in.	£71 5 0‡
35/45 ton tensile (EN6) (Usen) over 1 to 1½ in.	£67 3 0‡
0·4 carbon normalized (Usaspead "40") over 1½ to 2 in.	£69 5 0‡
0·45 carbon normalized EN9 (Usaspead 55)	£69 15 0‡
Carbon manganese steel to Specification EN16T (Usaspead 5565), per ton	£127 1 6

Ground Flat Stock

18-, 24-, and 36-in. lengths (Usaspead). List prices plus 10 per cent less 5 per cent.

Oil Hardening Cast Steel

Non-shrink (Usaspead N.S.O.H.), ¾ in. to 2½ in. per lb.	1s. 11d.
Non-distorting heavy duty (Usaspead H.C.H.C.), ¾ in. to 2½ in., per lb.	4s. 2d.

Silver Steel

(0·194-in. to 1½-in.). Genuine Stubs quality, per lb.	4s. 10d. less 27½%
M.M.C. quality, per lb.	2s. 8d. + 6½%
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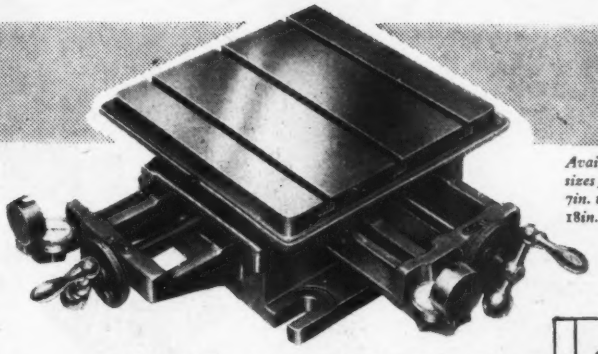

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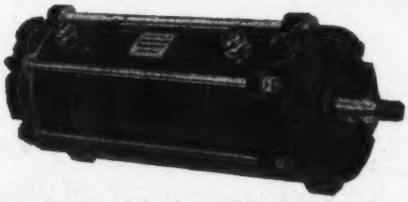

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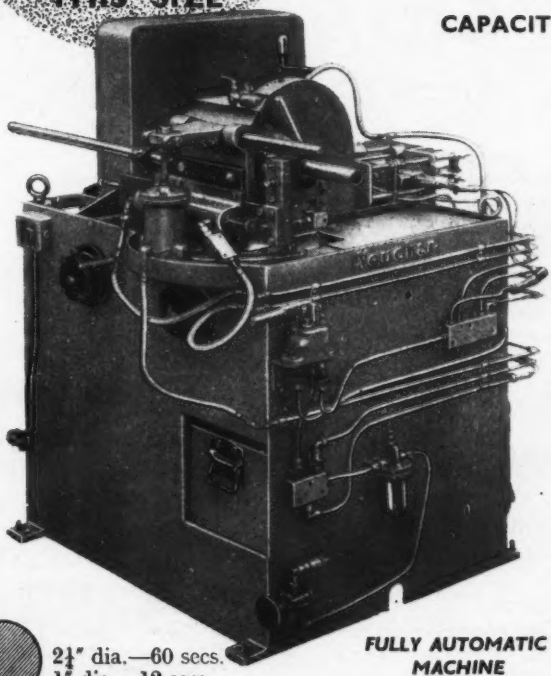

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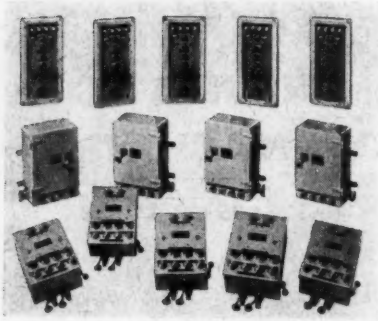

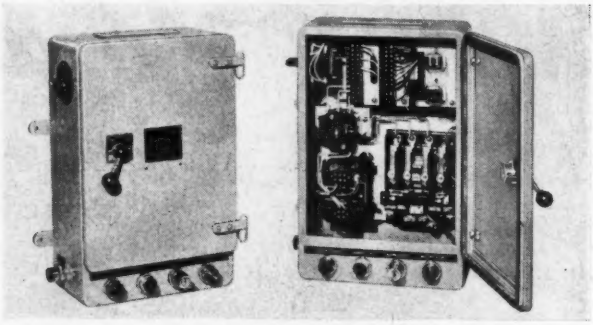

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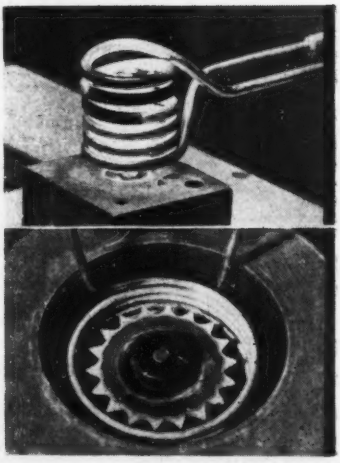

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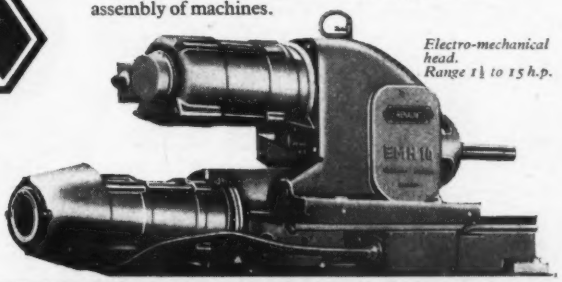

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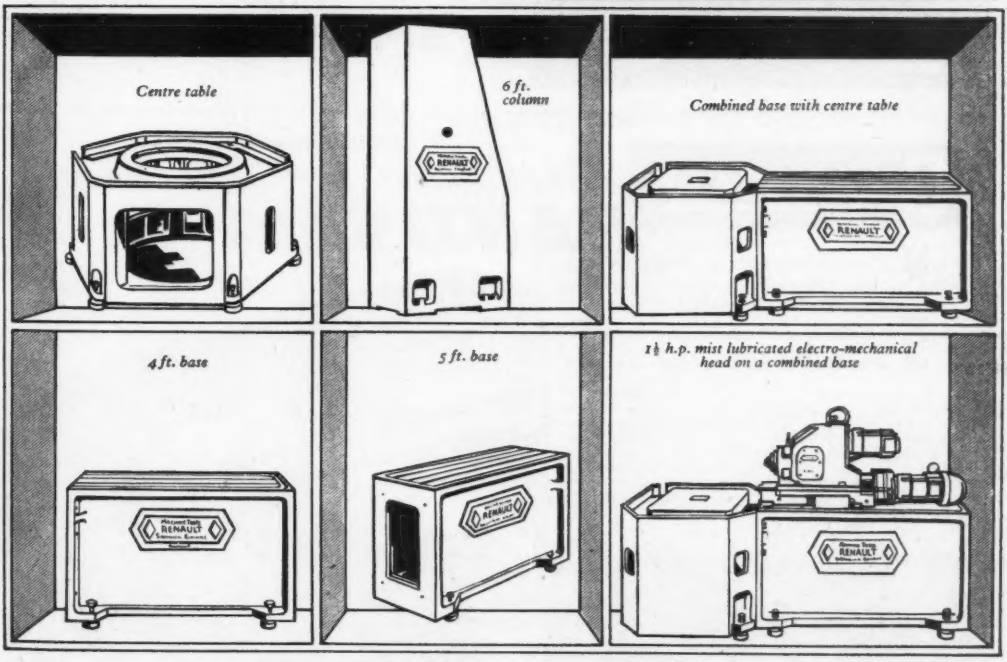
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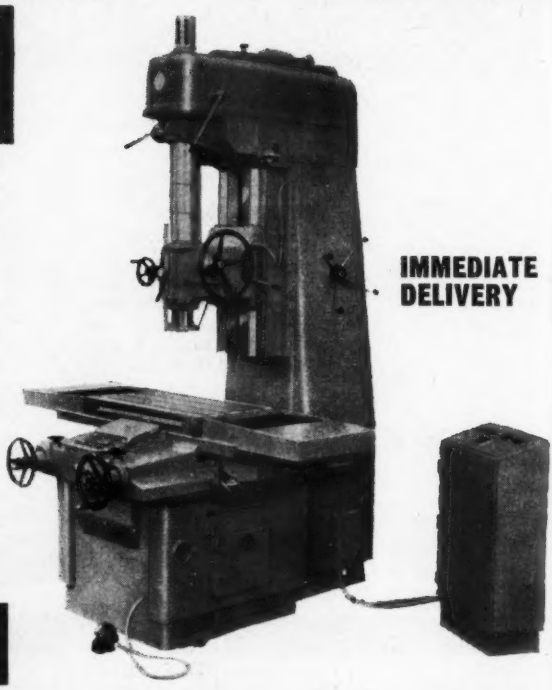

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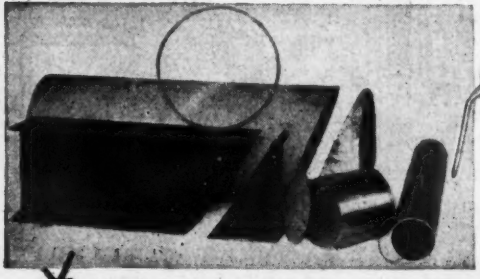

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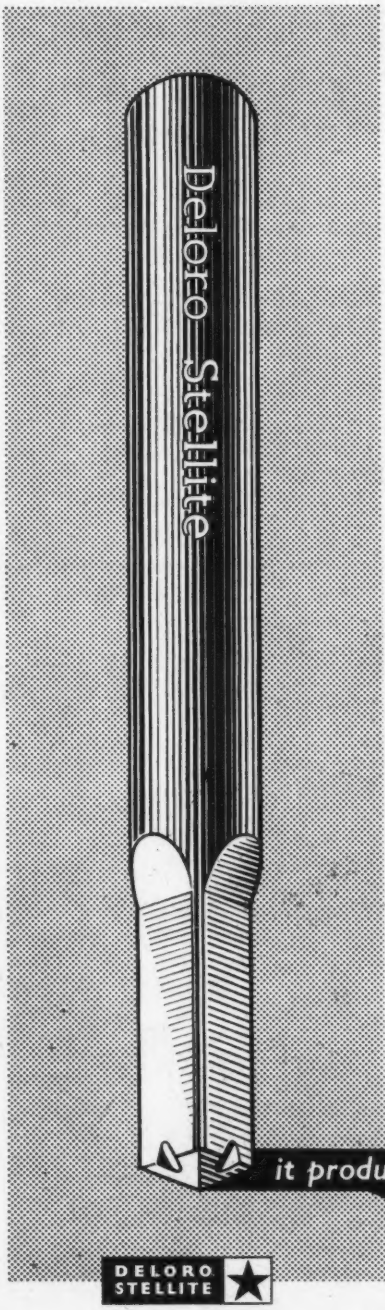

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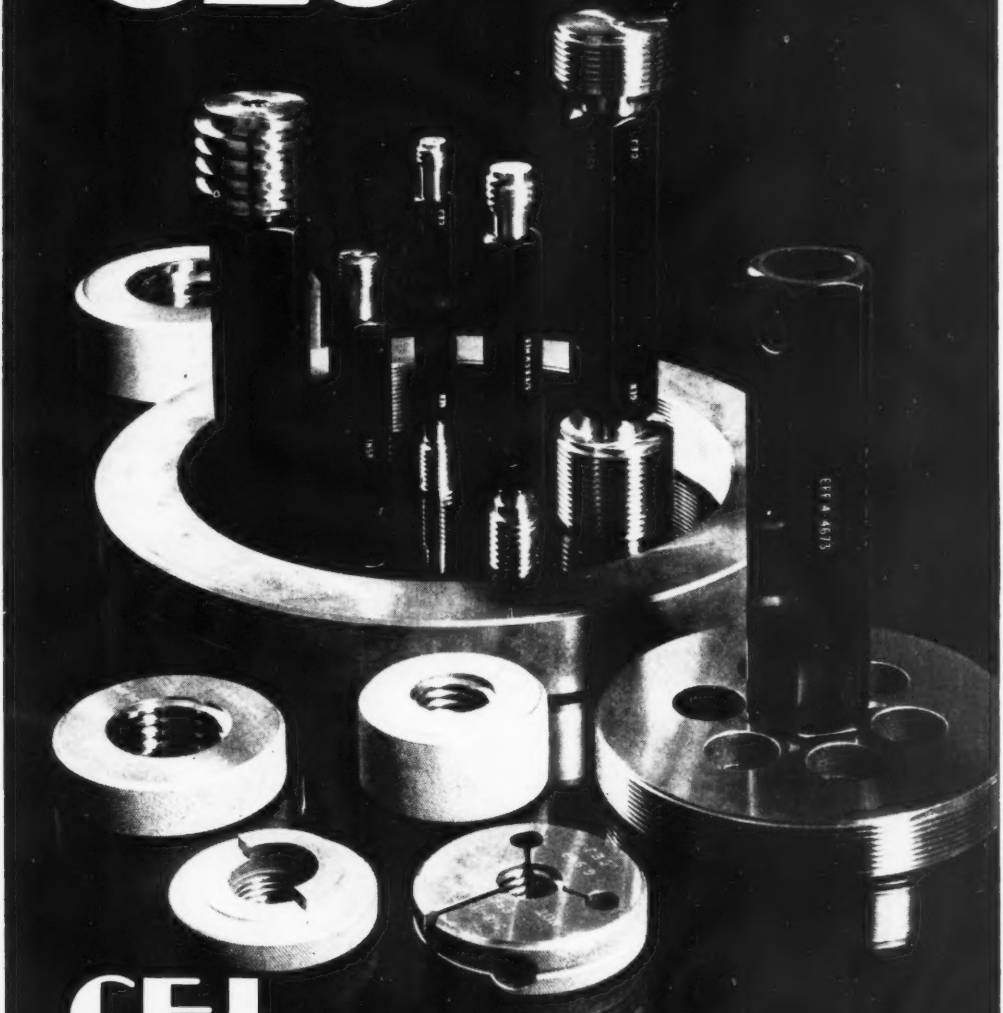

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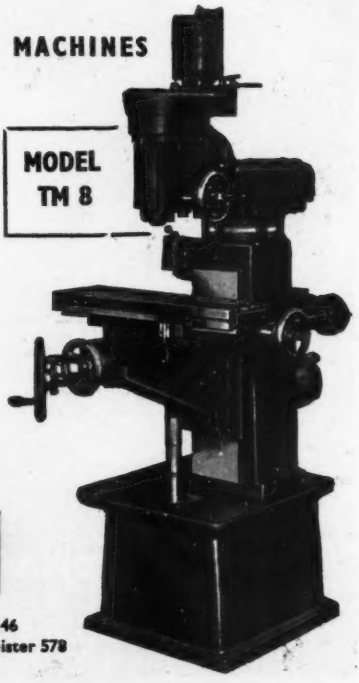

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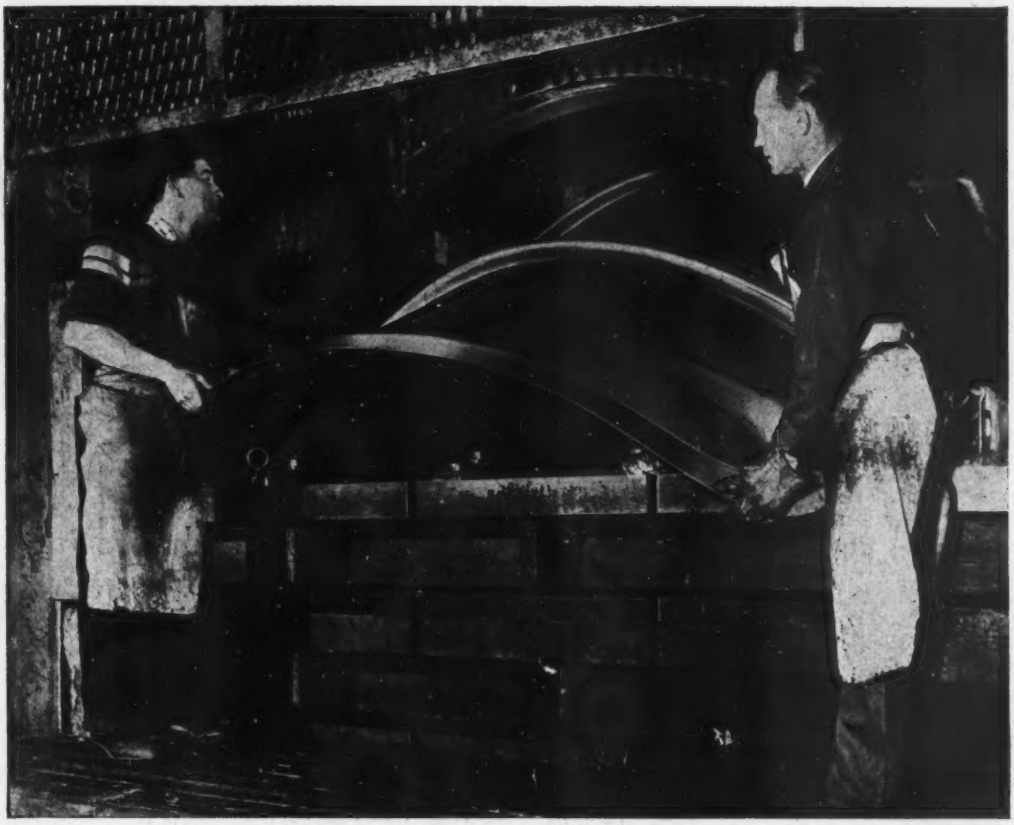

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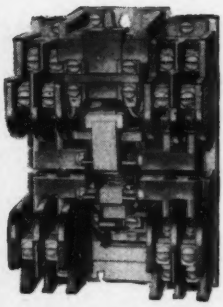

8-pole Open Style Relay with one auxiliary changeover circuit contact.

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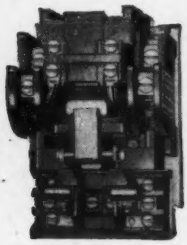

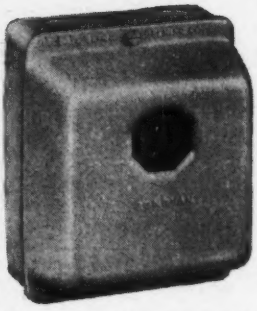

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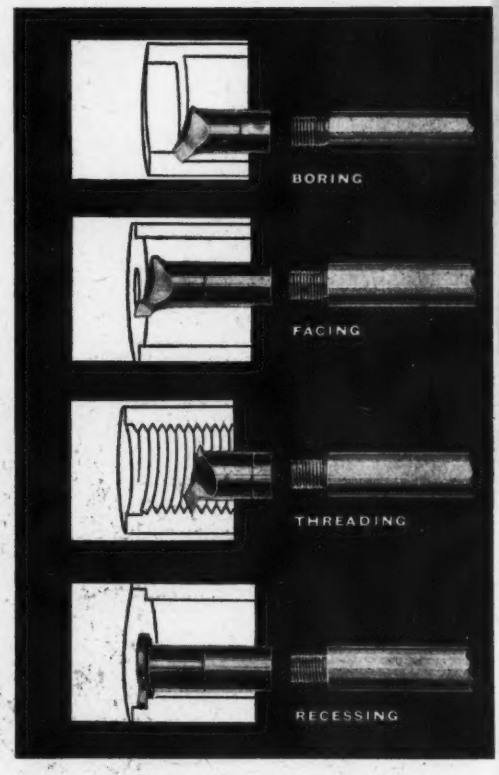

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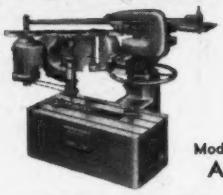
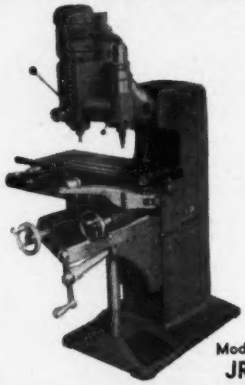
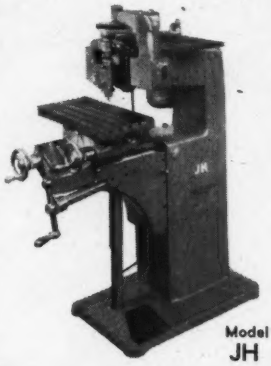


Model A

Model D



Model JR



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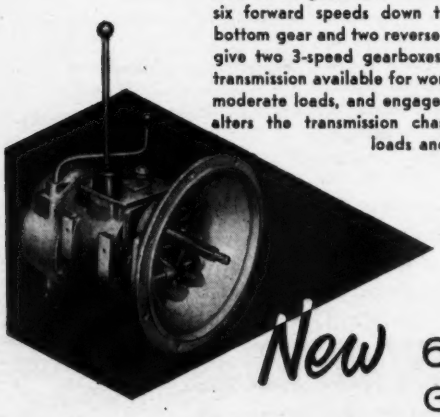

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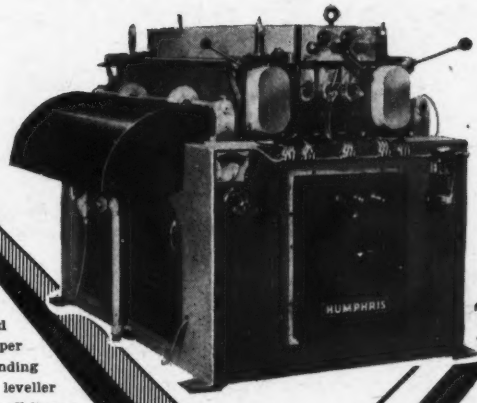
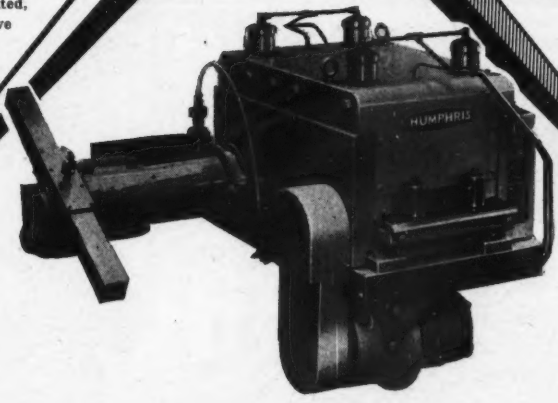


The three machines illustrated embody new techniques for combining the functions of feeding and levelling coiled strip. The upper illustration is of a free standing electro-mechanical feeder leveller suitable for press feed or cut-off lines. Illustrated right is a smaller, floor-

NEW Machines for Strip Levelling & feeding

mounted machine, embodying a different feeding principle, but with similar application. The lower illustration shows a new combined roll feed and leveller, press mounted, with rack and pinion drive and threading motorisation, suitable for handling very thick material.



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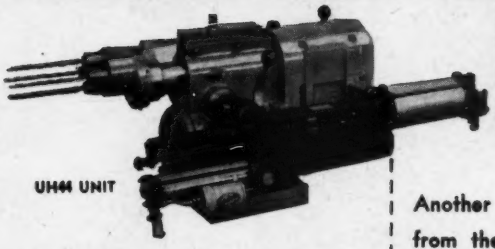
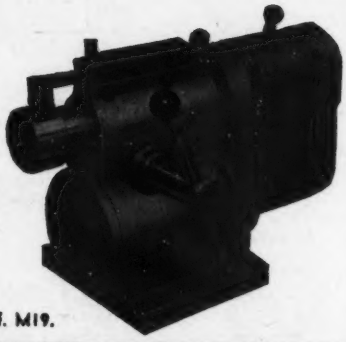


UH44 UNIT

Above is shown Unit Head type UH44, fitted, in this example, with automatic hydraulic / pneumatic feed control and provided with four spindle speeds. The multi-spindle drilling attachment was designed to suit special requirements.

Another Unit Head from the GRIMSTON range, this model is available with 4, 8, 12 or 16 spindle speeds, arranged with manual or geared power feeds.



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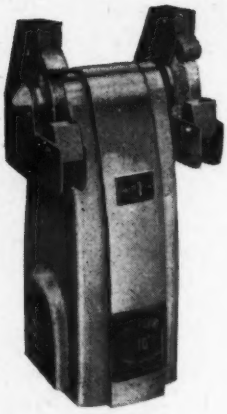
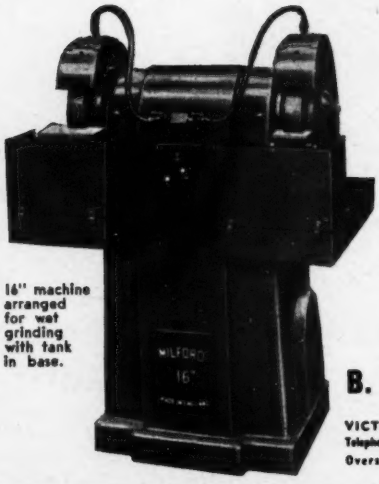


Standard 10" machine



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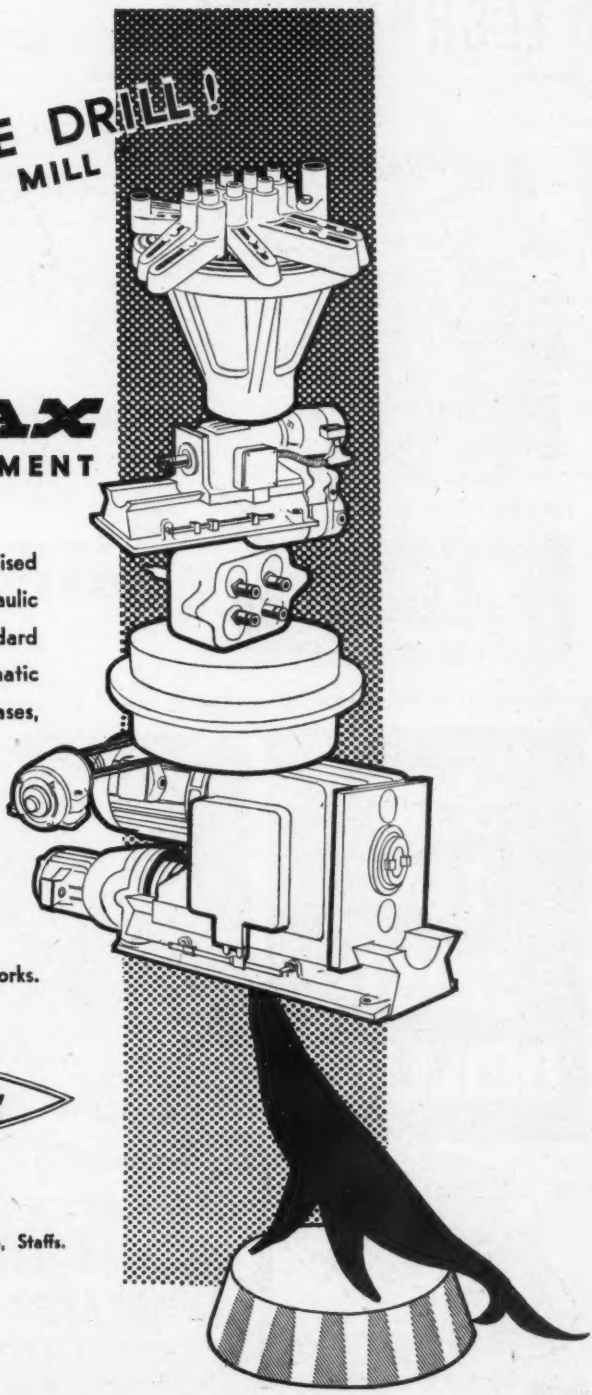

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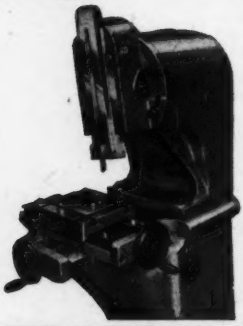

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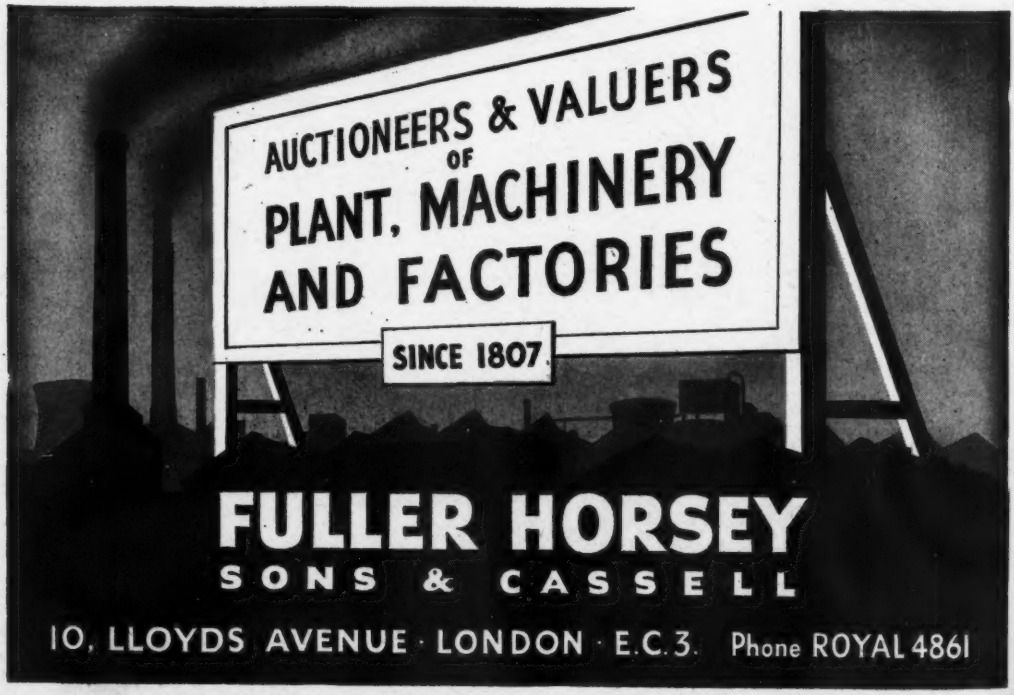

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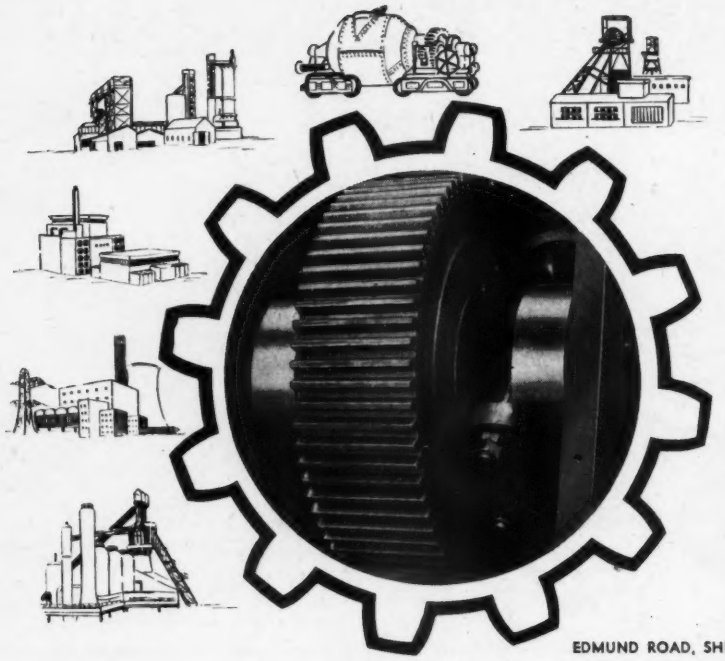

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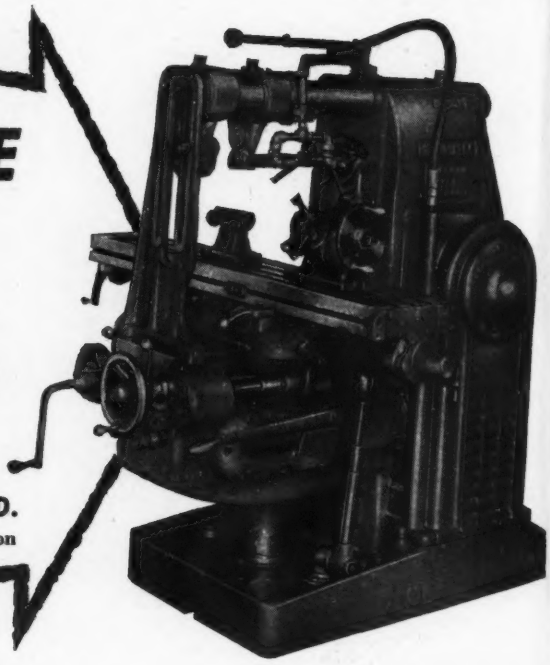

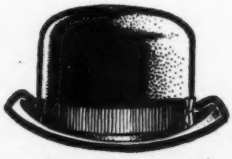

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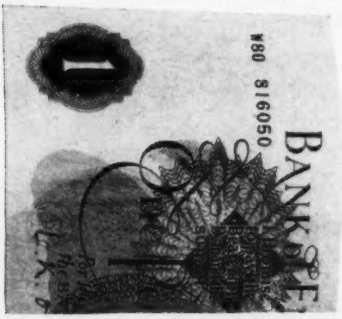

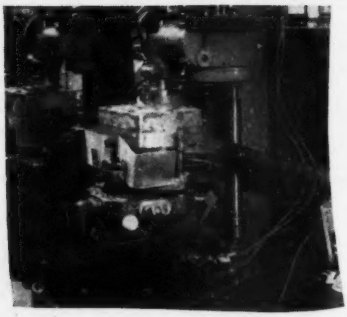

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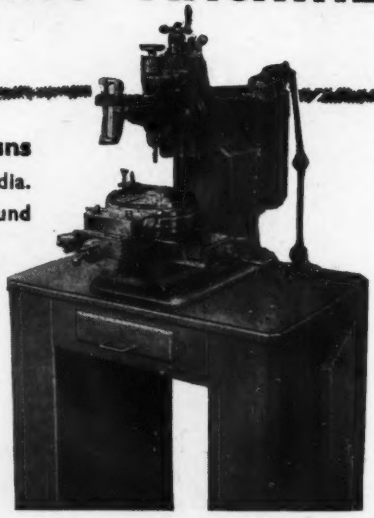

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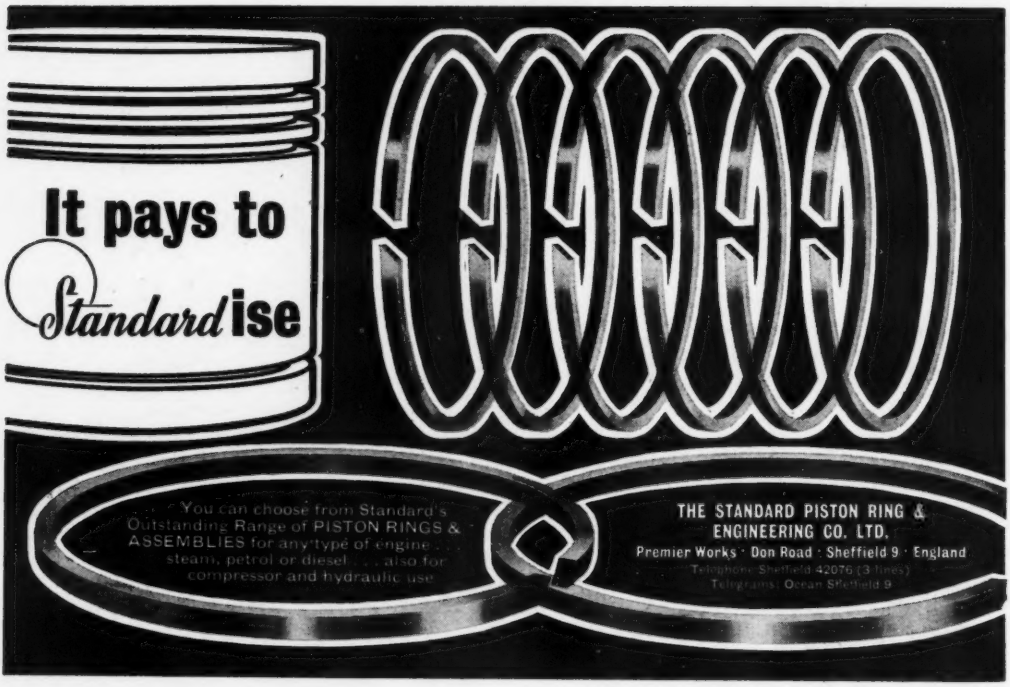
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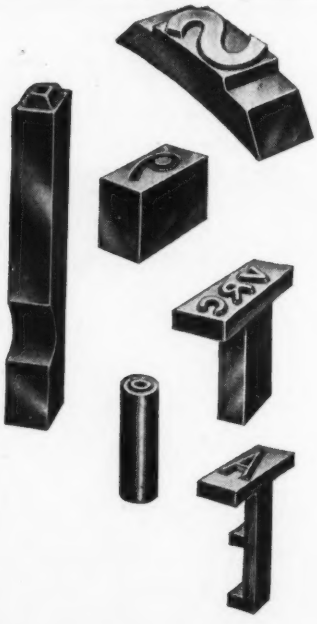

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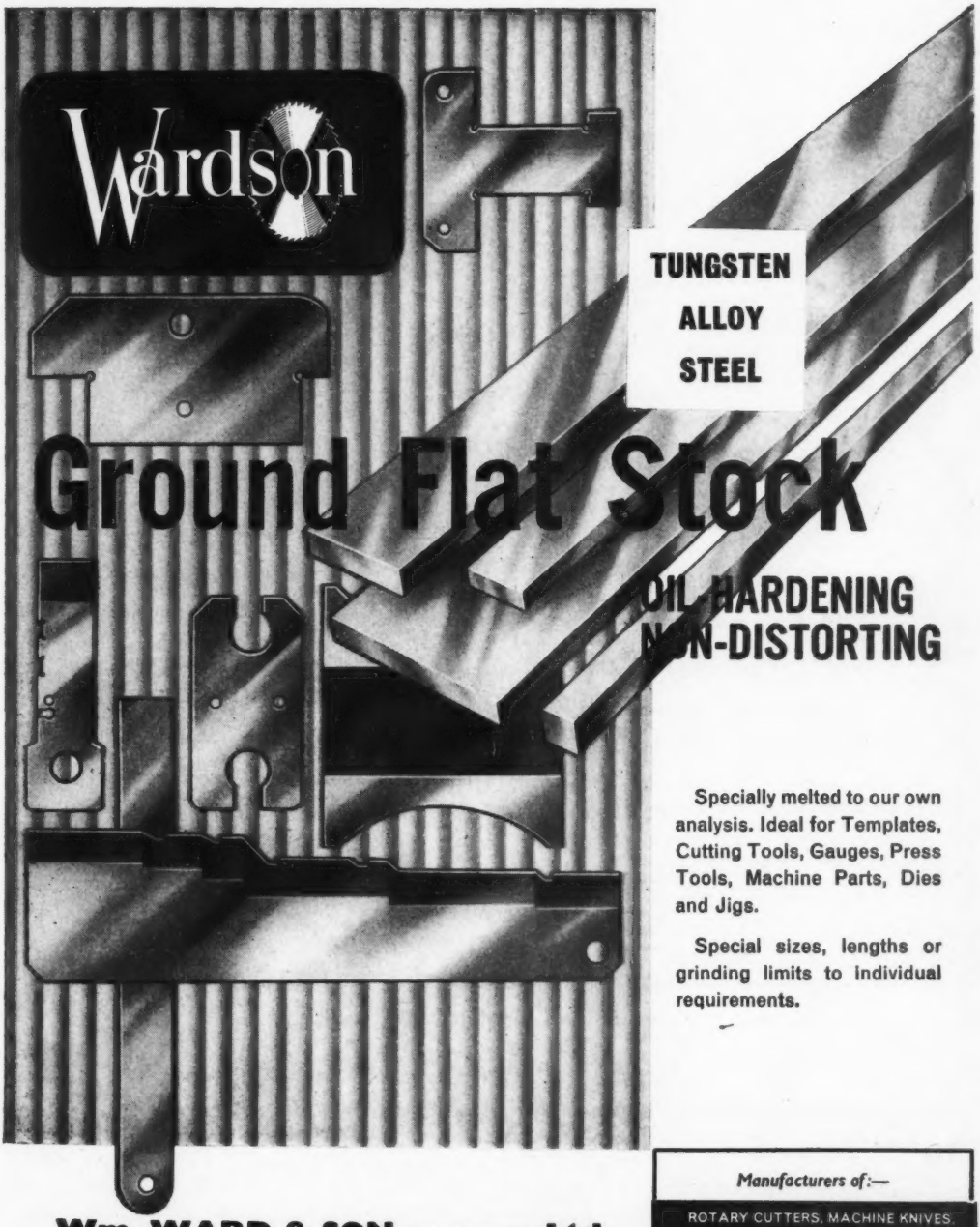

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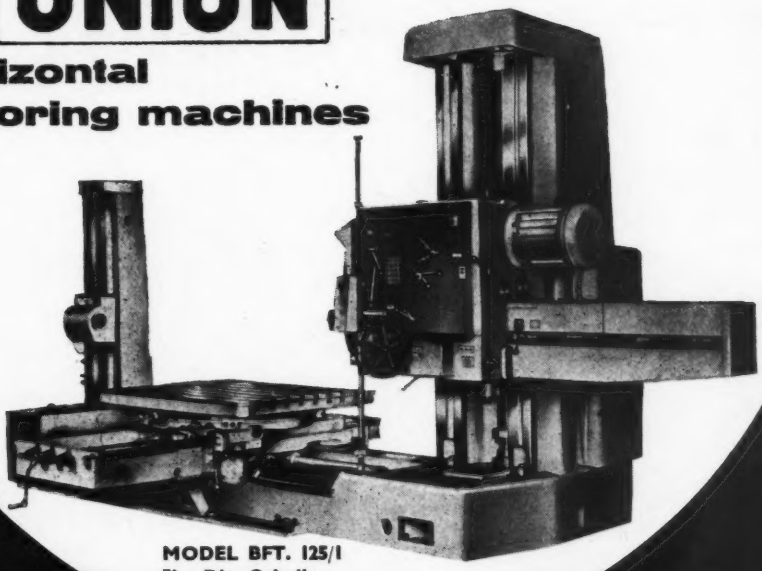

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Max. dia. faced	25in.	32in.	48in.	55in.
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Max. distance between Facing Head and Outer Support	5ft. 11in.	7ft. 5in.	9ft. 4in.	11ft. 10in.
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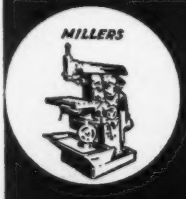

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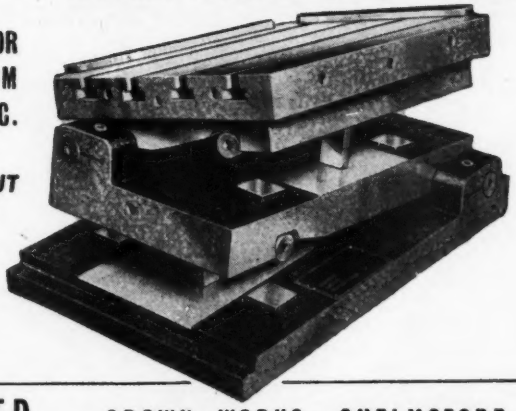

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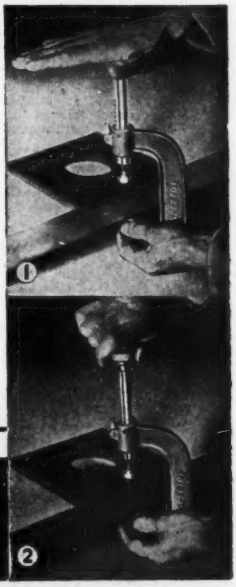

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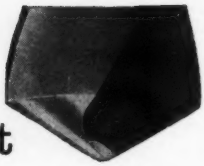

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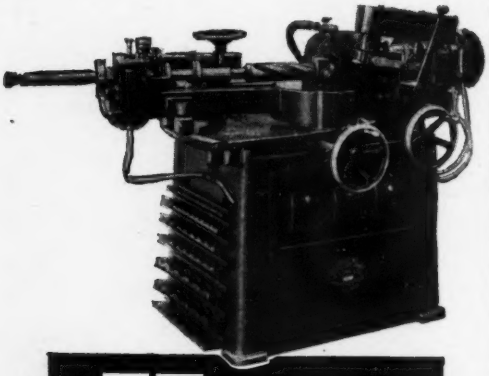

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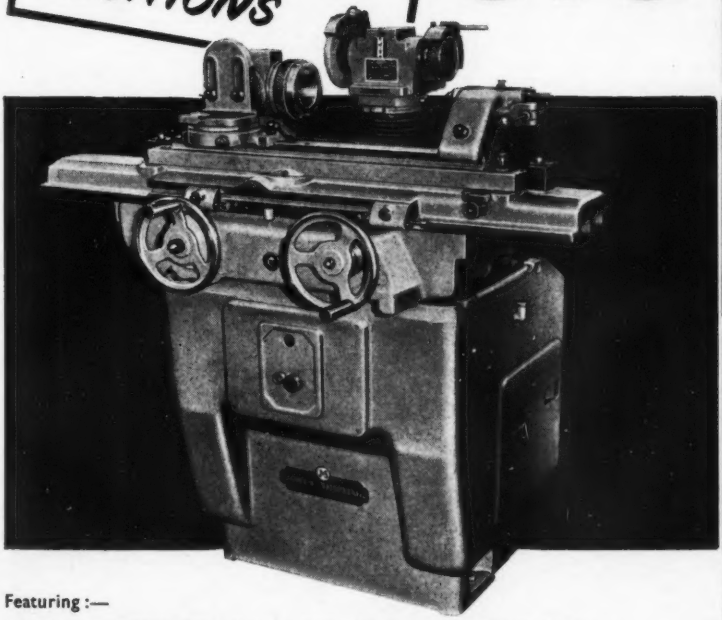

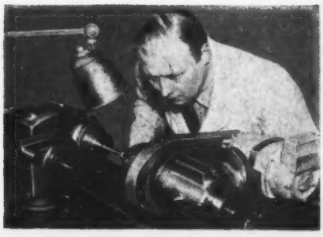

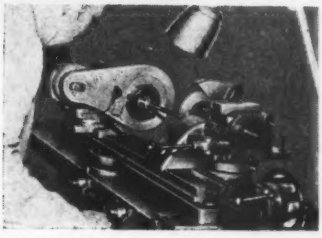

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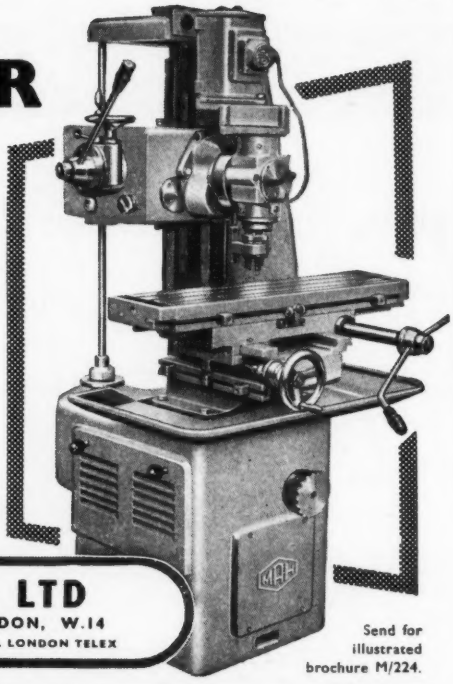

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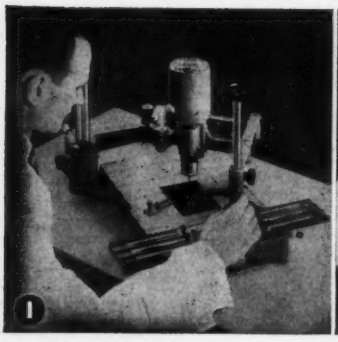

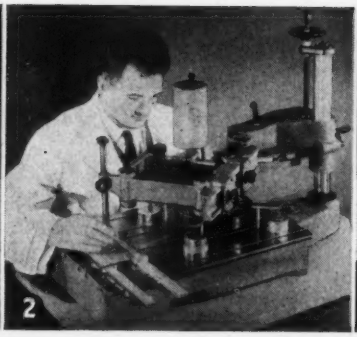

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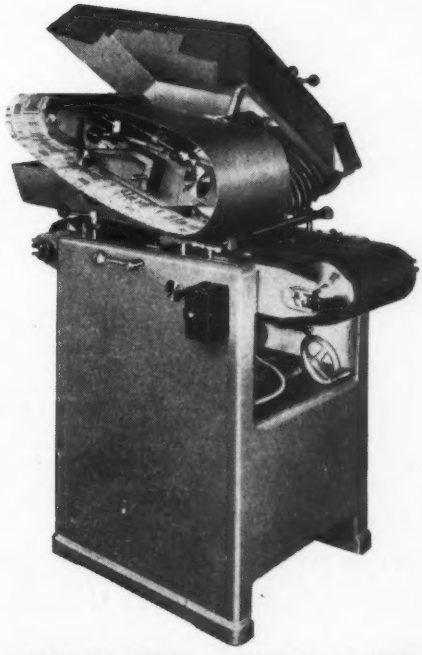

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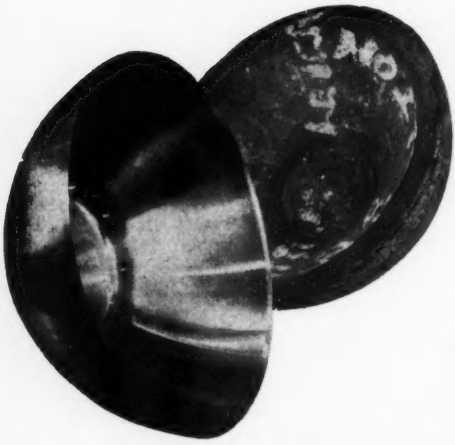

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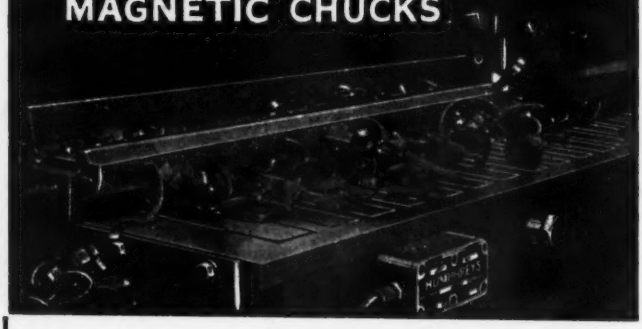

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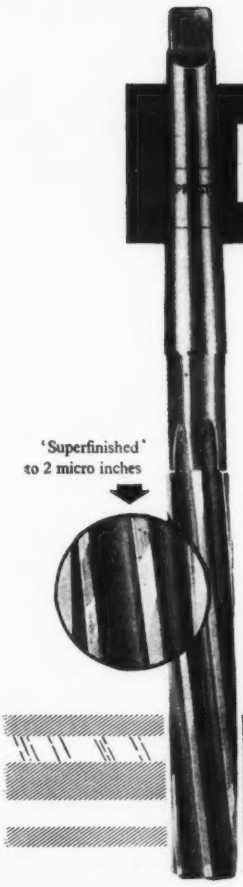

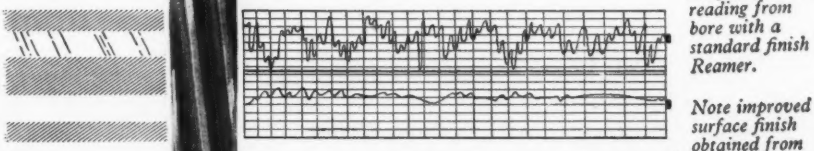

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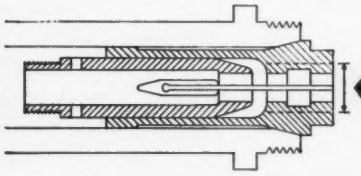

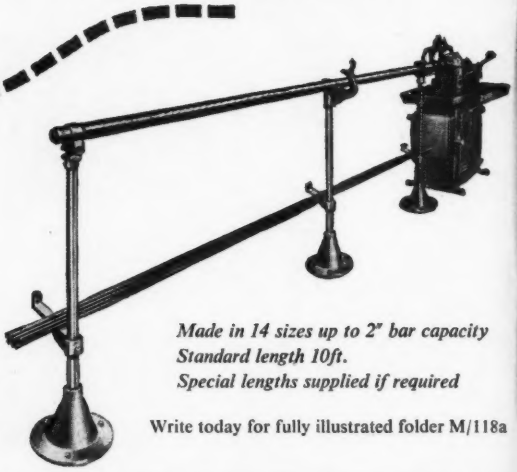

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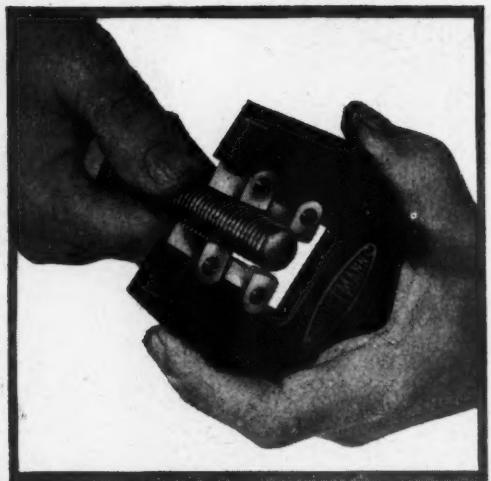

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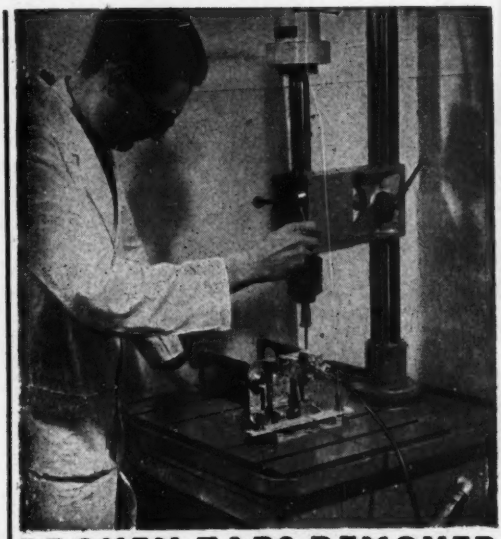

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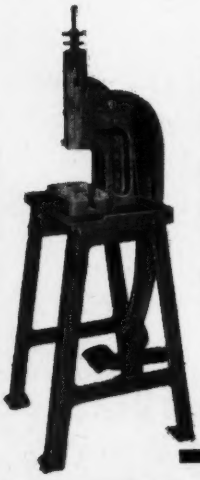

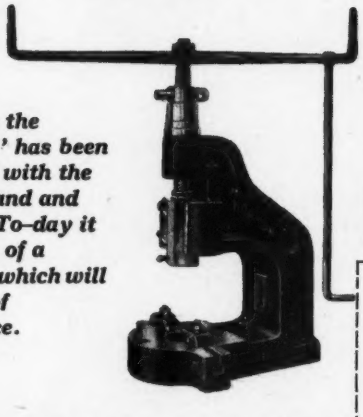

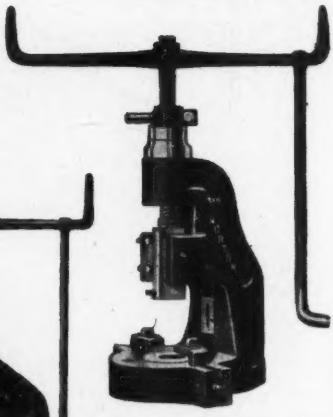

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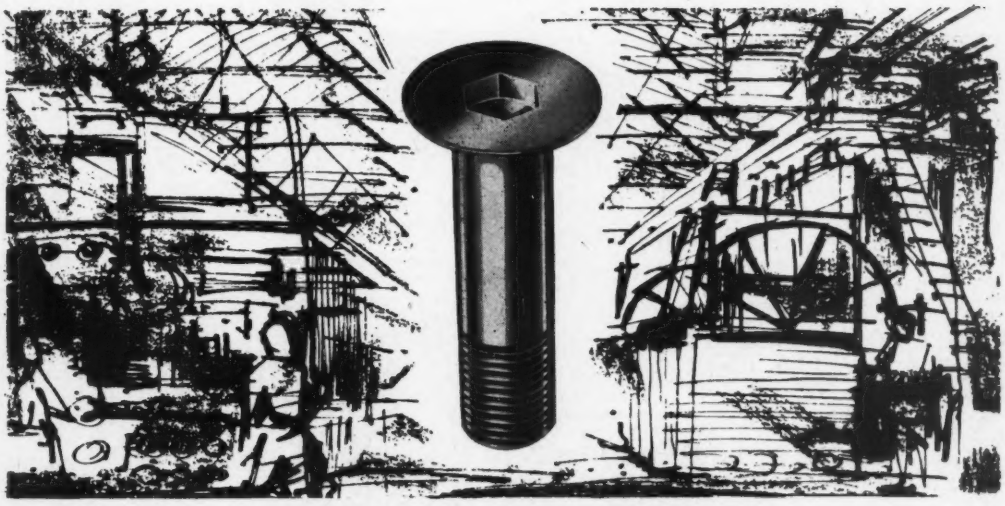

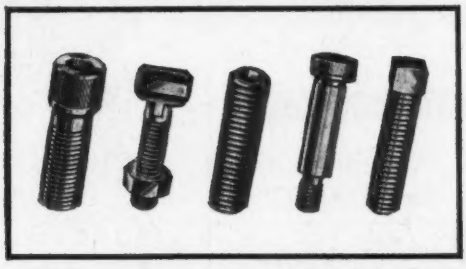

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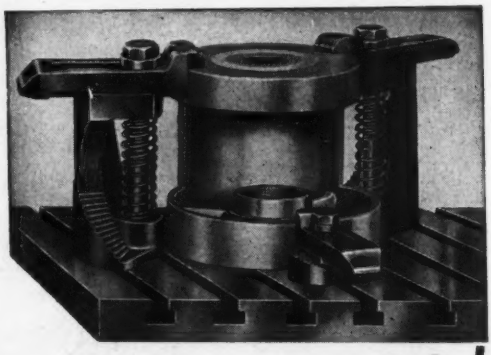

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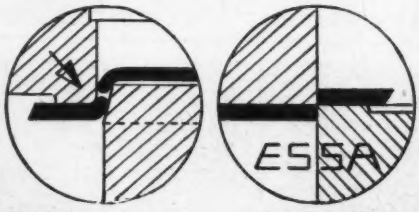

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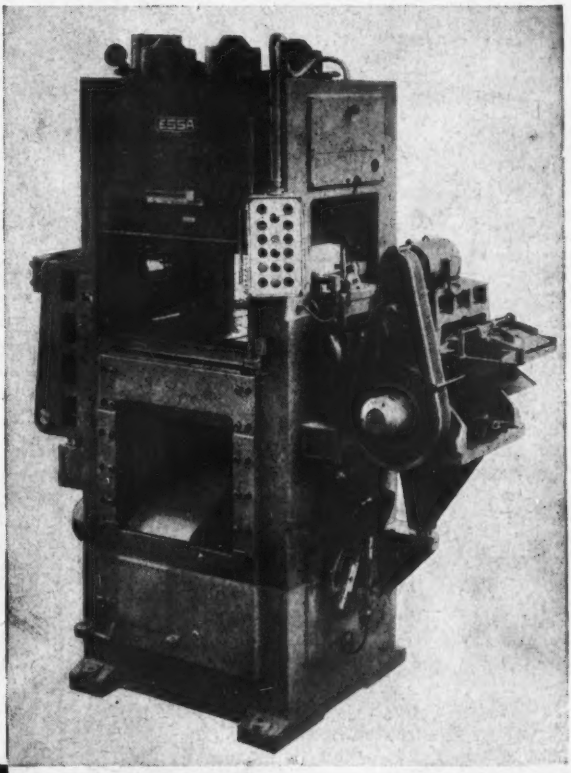

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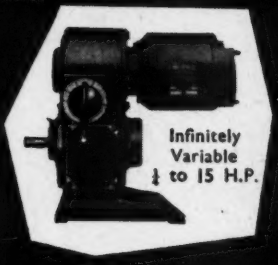

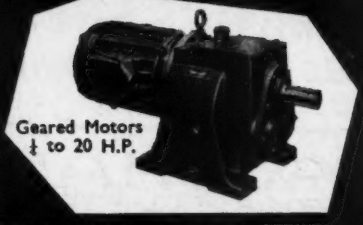

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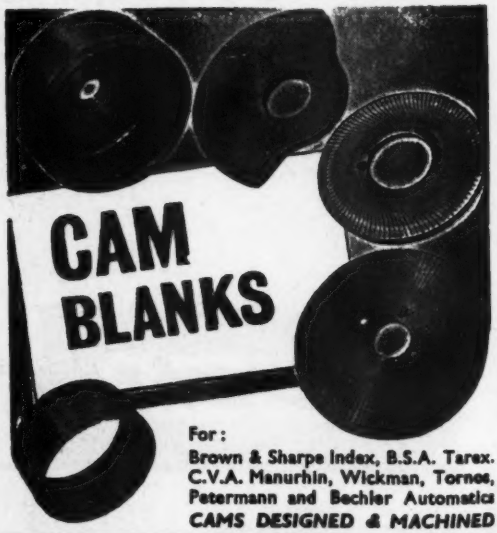

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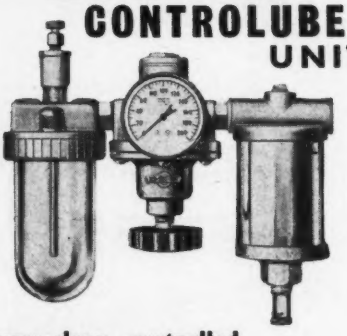

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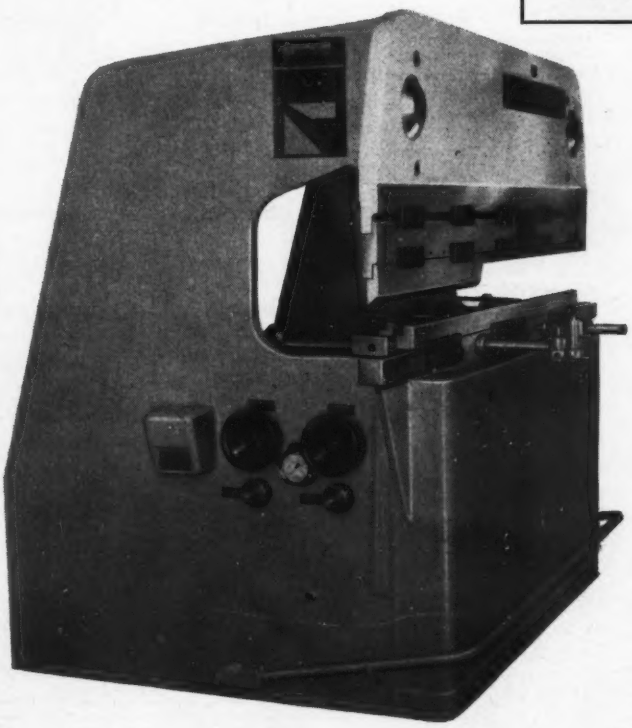

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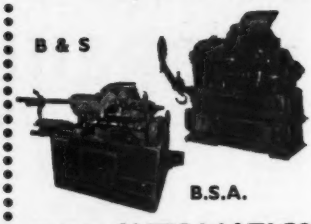

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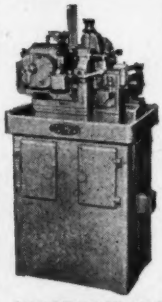

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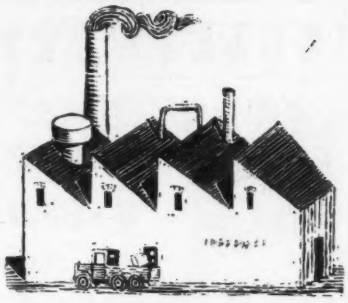

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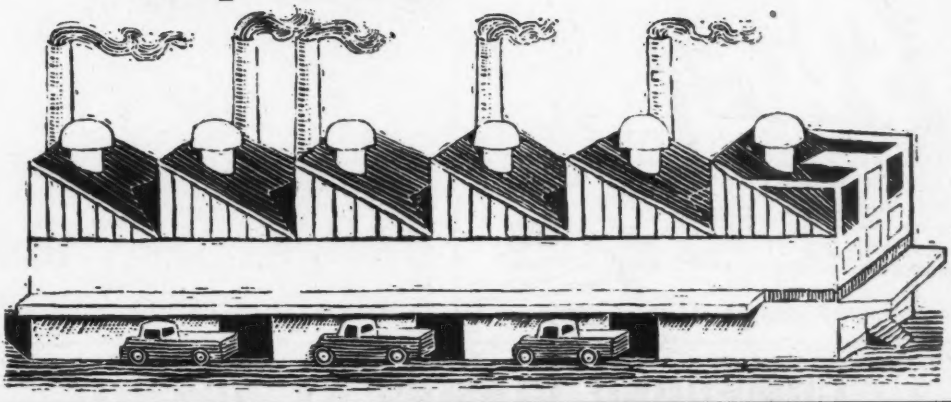

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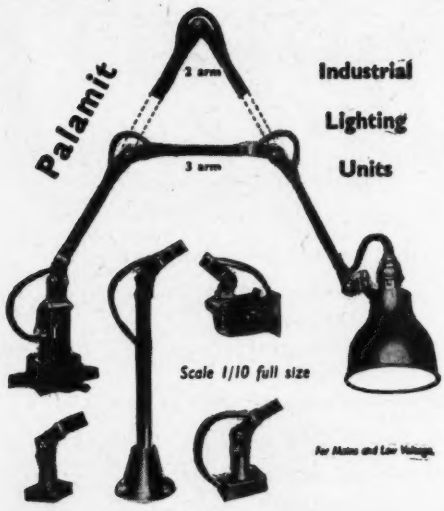

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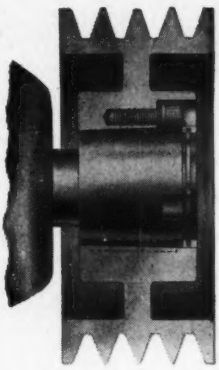

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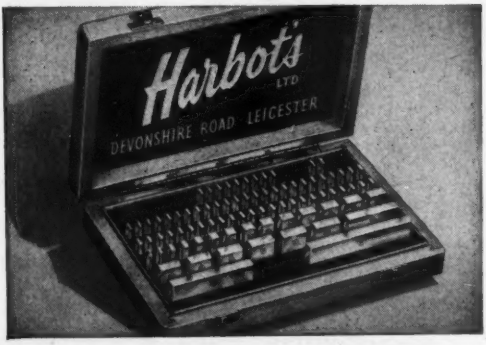

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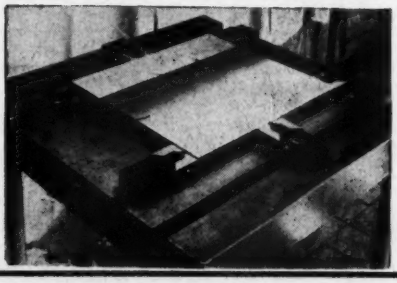

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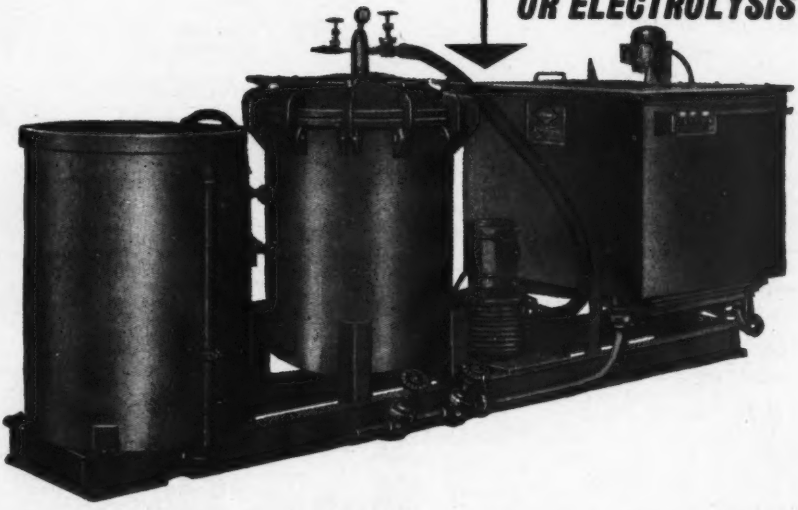

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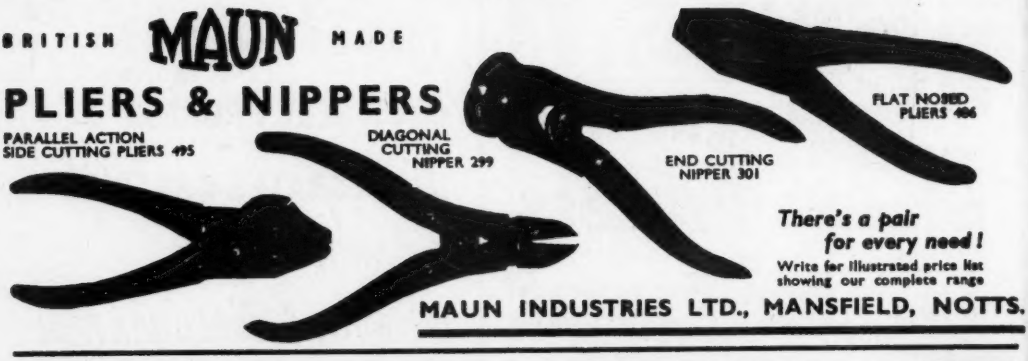

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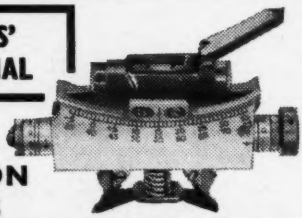

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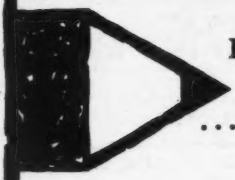

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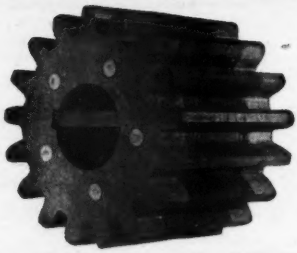

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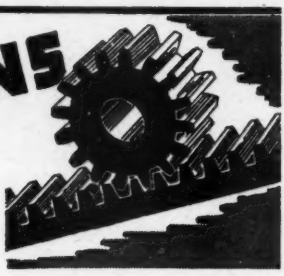

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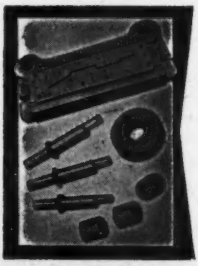

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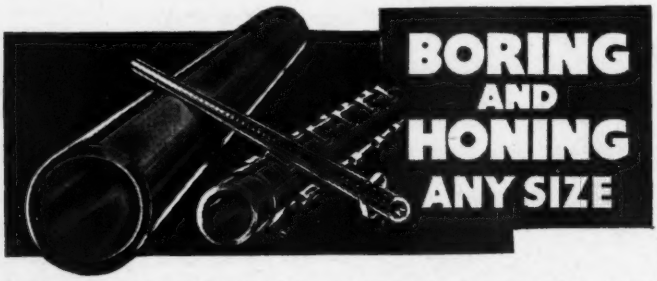

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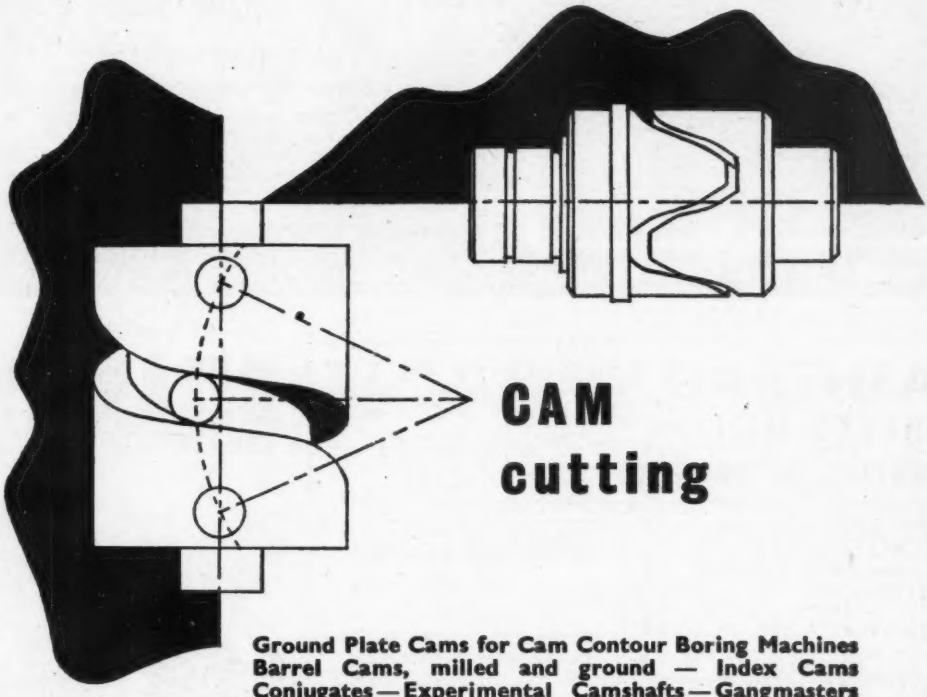

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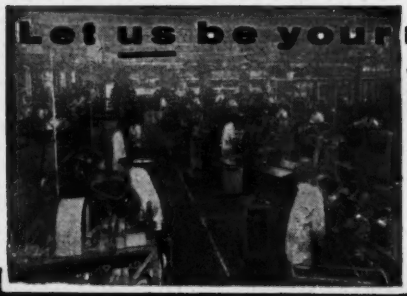

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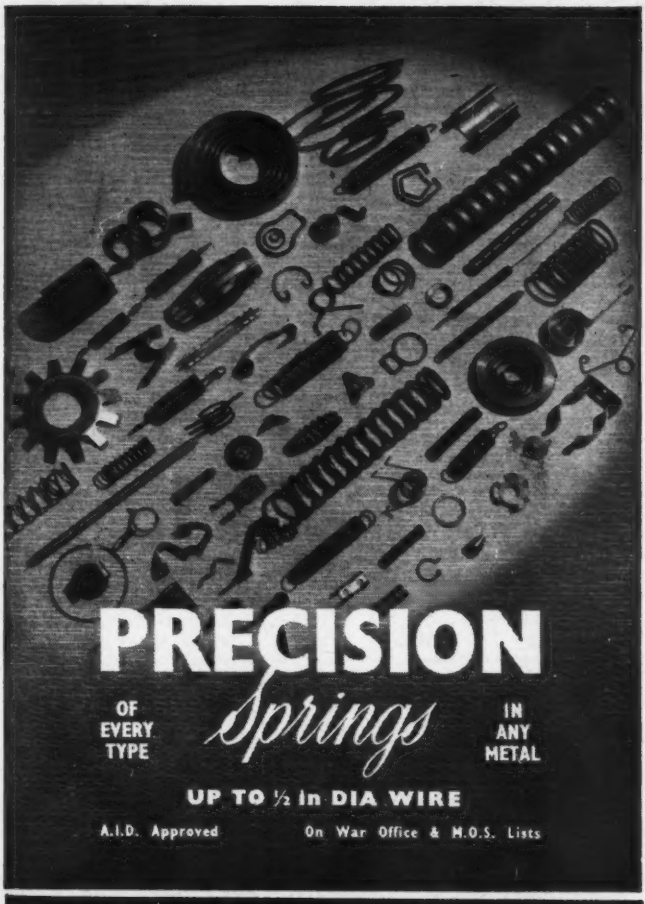

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MATRIX 10 by 16 Thread Grinding Machine.

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WARD 3A Capstan Lathe.
HERBERT No. 9 Combination Turret Lathe. 4½in. Spindle Bore.
WARNER & SWASEY 4A Turret Lathe. 8in. Spindle Bore.

LATHES S.S. & S.C.

MONARCH 7in. by 30in. S.S. & S.C. Lathe. Fully equipped.
LE BLOND 11½in. by 96in. S.S. & S.C. Lathe. Fully equipped.
SWIFT 122in. by 10ft. 6in. S.S. & S.C. Gap Bed Lathe. Spindle Bore 4½in.

LATHES—GENERAL

CHURCHILL-REDMAN S.S. & S.C. Boring Gap Bed Lathe. 24in. swing over Saddle. 3½in. Spindle bore.

MILLING MACHINES

MILWAUKEE 2K Vertical Milling Machine.
CINCINNATI No. 3 Dial Type High Speed Vertical Milling Machine.
CINCINNATI No. 3 Dial Type Medium Speed Vertical Milling Machine.

PLANING MACHINES

BUTLER 14ft. by 5ft. by 5ft. Heavy Duty Double Column Planing Machine.
KENDALL & GENT Horizontal Spindle Openside Plano Milling Machine. Table size 36in. by 120in.

SCREWING MACHINES

KENDALL & GENT 2—1¼in. Screwing Machine. Capacity 1½in.

SHAPING MACHINES

ALBA 12in. Shaping Machine.
CHURCHILL-REDMAN 18in. Heavy Duty Shaping Machine. Equipped with swivelling table and machine vice.
CHURCHILL-REDMAN 24in. Heavy Duty Shaping Machine. Equipped with swivelling table and machine vice.
KELLY 28in. Heavy Duty Shaping Machine.

ALL MACHINES, OFFERED IMMEDIATELY EX-WORKS

COWHILL LANE, ASHTON-U-LYNE, LANCS.

Phone: ASHTON 3631/2. Grams: "HARTOOLS" ASHTON-U-LYNE

12½in. Centre "Swift" 16ft. 6in. h.c. heavy duty m/d all-gd. hollow spindle S.S. & S.C. Lathe, with two saddles each with taper turning attachments. 20 H.P. 400/3/50 motor, 18 spindle speeds 1.5–91 r.p.m. Spindle mounted in 'Timken' roller bearings.—LEE & HUNT, LTD., Crocus Street, Nottingham. Phone 84246.

Oerlikon Vertical Milling Machine. Swivelling head (register 15in. dia.). Table 55in. × 13in. 18 speeds. 12 feeds. Quick traverse. Quill dia. 7½in. 1951. In really excellent condition.—BLACKFRIARS PRECISION, LTD., 154, Blackfriars Road, London, S.E.1. WAT. 3131.

Churchill HBB Internal Grinder with Sizematic Attachment.
Further details from:—
C. & G. OLDFIELD, LTD.,
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PAISLEY.

Heald 70A Grinder, Serial No. 8023, height of spindle centre over bed 9in. Swivel workhead 450 deg. each way. Workhead motor 1½ h.p. 230 volts, 12in. stroke, 9in. backplate on spindle nose, 5 h.p. wheel motor 420/3/50, ¾ h.p. table motor 420/3/50.—BOX D261, MACHINERY, Clifton House, Euston Road, N.W.1.

---

625 Ton Hydraulic Deep Drawing Press by Fielding & Platt, punch power 510 tons, blankholder 115 tons, 72in. × 63in., bottom cushion, self-contained pumping unit, with automatic and manual control.
200 ton Open-fronted Straightening Press by H.E.C., table 3ft. × 3ft.
Many other Hydraulic Presses for all duties.
REED BROTHERS (ENGINEERING) LTD., Mr. C. E. M. Hardie — Receiver and Manager, Replant Works, Woolwich Industrial Estate, London, S.E.18.
Tel.: Woolwich 7611.

M. WARD

(Machine Tools) Ltd.

1, KILBURN HIGH ROAD, LONDON, N.W.6
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'Grams': Emwarneers, Kilb., London

LATHES

LE BLOND 13in. Regal S.S. & S.C., taper turning.
SOUTHBEND 14½in. × 36in. S.S. & S.C. Taper turning.
LANG Junior 17in. × 60in. S.S. & S.C.
LE BLOND 15RP S & S, 15in. × 24in.
CRAVEN 36in. Swing × 12ft. Between S.S. & S.C.
LANG 36in. Surfacing and Boring.
ACME No. 5W Capstan, chuck machine.
RYDERMATIC No. 12 Multi-Tool.
D.S.G. 13Z Minor S.S. & S.C.
WILLSON 6½in. × 36in. Gap Bed S.S. & S.C.

CAPSTANS AND AUTOS

HERBERT 2S, Flamard Bed.
WARD 1A.
WARD No. 7 Capstan, chucker.
HERBERT 4B D/L chuck and bar feed.
TAYLOR No. 1263 Capstan, ½in. cap.

DRILLS

HERBERT "C" 4-spindle Pillar.
KITCHEN & WADE 2ft. 6in. Radial Drill.
HERBERT Type "V" Junior Geared Pillar.
HERBERT Type "V" Pillar.
HERBERT Type "C" Pillar.
FOSDICK 4BM 3-spin H/sp.
CORONA 3M Pillar, 1½in. cap.
KITCHEN & WADE 2ft. 6in. Radial, 2in. capacity.

GRINDERS

CHURCHILL BY, 10in. × 20in. "live" and "dead" workhead.
LUMSDEN 30E 4-wheel carbide tool.
KEIGHLEY KN Internal.
BROWN & SHARPE No. 5 Surface.
BROWN & SHARPE No. 23 Plain, cap. 10in. × 48in.
BROWN & SHARPE No. 2 Surface, cap. 6in. × 18in.
SMART & BROWN Internal, 1½in. cap.
BROWN & SHARPE No. 5, 3in. × 18in. Plain.
BALLINGER 10/24 "Versatile" Abrasive Cutting-off Machine.
NEWALL Model L.U. 10in. × 36in. Hyd. Universal.
B.S.A. LANDIS Type C 6in. × 18in. Hyd. Plain.
CHURCHILL Mod. H.C.B. Internal Auto Size.
HAHN & KOLB Hyd. Disc Lapping M/c.
JACKMAN No. 22 Disc, 18in. dia.
LUMSDEN Mod. 12M Tool, 14in. × 2 wheel.

MILLERS—Vertical

VAN NORMAN IV, adj. throat, swivel head.
REED PRENTICE 3VG.
CINCINNATI Model 08 Production.
KENDALL & GENT Duplex Profile, table 15in. × 15in.

MILLERS—Horizontal

MILWAUKEE 1848 Simplex Bed Type Production.
CINCINNATI No. 2MH Plain High Speed.
CINCINNATI Mod. 08 Plain Automatic.
RICHMOND 2HS Plain, table 35in. × 9in.
ARCHDALE 20in., table 40in. × 10in.
CINCINNATI Mod. O.K. Prod., table 34in. × 12in.
ARCHDALE 14in. Plain, table 27in. × 8in

SAWING MACHINES

EHJ No. 13 Filing and Sawing.

SHAPERS

TOWN 14in.
HERBERT N.D. 20in.
ORMEROD 14in.

GEAR CUTTER

MAXICUT Gear Shaper, Mod. No. 2.

MISCELLANEOUS

T.T. & H. Javelin Etchers. Multi-heads (3 m/cs).
HEAP 2in. Screwing Machine.

Classified Advertisements (*PLANT FOR SALE, contd.*)

POWER PRESSES IN STOCK

NEW PRESSES

BENTLEY 80 ton Adjustable Stroke, Geared.
HERCULES 40 ton Adjustable Stroke, Geared.
MARTYN 18 ton Blanking Press.
WORCESTER 6 ton Power Presses.

USED PRESSES

JOHN SHAW 700 ton Hydraulic Press, 4 column type. Admits 6ft. × 4ft. on bed area. Daylight 4ft.
RHODES 100 ton Double Crank Press. T/S 5ft. × 3ft. 6in. × 4in. stroke.
CRAIG & DONALD 100 ton Double Sided Geared Press. 6in. fixed stroke.
DANIEL SMITH 75 ton Geared Open Fronted Blanking Press. 1¼in. stroke.
RHODES 30 ton Horn Press. Adjustable stroke 3in.
E.M.B. Flexi-Press. 30 tons. 17¼in. stroke.
BRADLEY & CRAVEN 25 ton Open Fronted Press, 2¼in. fixed stroke.
BLISS 12 Station Dial Feed Press, 2in. adjustable stroke.
SWEENEY & BLOCKSIDGE No. 9 Open Fronted Press. 1¼in. fixed stroke.
H.M.P. 20 ton Open Fronted Press. 2in. fixed stroke.
HEALEY 20 ton Open Fronted Press. Adjustable stroke ¼in.-3¼in.
WARD 20 ton Open Fronted Press. 2in. fixed stroke.
SWEENEY & BLOCKSIDGE 10 ton Open Fronted Press. Adjustable stroke ¼in.-2¼in.
TURNER 6 ton Open Fronted Press. 2in. fixed stroke.
DANIELS Paletting Press.

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MARTIN POOLE LTD.,
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NEW FREDK. POLLARD Model 12MXT CORONA

Adjustable Multi-Spindle Column Drilling & Tapping Machines complete with 12 off (6 per machine) No. 1 Adjustable Spindle Bracket Assemblies and Coolant Equipment

Box D190
MACHINERY, Clifton House, Euston Rd., N.W.1

Landis 18in. Cam Grinder For Sale.—BOX D210, MACHINERY, Clifton House, Euston Road, N.W.1.

U2 Victoria Rapidmill (New). Delivery ex-stock.—J. P. SUMMERS (SOUTHAMPTON), LTD., Maybush Road, Wimpson Lane, Southampton.

Bryant No. 4 Internal Chucking Grinder. Capacity ¼in.-2in. bore. Max. swing 6¼in. dia. Motorised.—WILCOX & CO., Barr Street, Birmingham 19. NORthern 1234.

Holbrook Toolroom Centre Lathe, 6¼in. centres × 30in. Taper turning attachment, three jaw chuck, four jaw chuck, faceplate, catchplate and steady, 400/3/50.—H. BYWATER, New Spring Street, Birmingham. CEN 5795.

K·E·N·T

PRESSES

Hammerle 60 ton Hydraulic Press, 14in. max. stroke, 28in. × 36in., table as new.
C.V.A. 10 ton Dieing Press.
Rhodes Incl., 25 ton.
Weingarten Incl., 30 ton.
Edwards Incl., 18 ton, Var.
Hi-ton 3 ton Hydraulic.
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LATHES

8¼in. **Holbrook** Model B Collets.
8¼in. **Pratt & Whitney.**
14in. × 14ft. **Betts Bridgeford.**
18in. × 12ft. **D.S. & G. S. & S.** only.
Student 6in., with equip.
Le Blond 7¼in. Gap Bed.

MILLING MACHINES
Vertical

Archdale 18in., 40in. × 10in.
Herbert 15S, 49in. × 11in.
Jason SI and Sw head.

Horizontal

Archdale 20in.
Reiden H.F. 30, 60in. × 14¼in.
Archdale 14in. Hor.

CAPSTAN AND TURRETS

Ward 7 Capstan, covered bed.
Ward 7 Comb. lathe.
Murad 34 ¼in. Capstan Lathe.
Modern 1¼in. Capstan Lathe.

GRINDERS

Brown & Sharpe No. 2 Surface.
Robot No. 2.
J. & S. Univ. and T. & C.
Abwood Vertical Surface.

DRILLING MACHINES

Archdale 4ft. Radial, 2in. cap.
K. & W. 3ft. 6in. Radial, 1¼in. cap.
Corona 2 spindle 3 M.T., power feed.
Archdale Vert. drill with floating table.

MISCELLANEOUS

Holroyd AN6 Thread Mill.
Artos Cutting-off Machine.
Alba 14in. Shaper.
Invicta IM Shaper.
Hutto Vertical Honer.
Newall Lapper.
Electricar Truck and charging panel.
Tauco Abrasive Cut-off.
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All motorised 400/3/50.

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18in. 'Rapidor - Manchester' Hacksaw, 3 h.p. Motor, Geared Sud Pump and Vice. Further details from:—

C. & G. OLDFIELD, LTD.,
15, Abercorn Street,
PAISLEY.
Member of B.A.M.T.M.

36in. "Lang" m/d All-gd. S.S. & S.C. Chucking Lathe with taper turning attachment and 30in. four-jaw chuck. Admits 36in. between chuck and saddle. 20 h.p. 400/3/50 motor. 12 spindle speeds 8.5-403 r.p.m. Spindle bored 2¼in. dia. mounted in "Timken" roller bearings.—LEE & HUNT LTD., Crocus Street, Nottingham. 'Phone: 84246.

Le Blond Lathe, Serial No. NE4623, 10in. height of centres × 40in., 6 spindle speeds 67 to 450 r.p.m., 2¼in. spindle bore. Auto feed to saddle and cross slide. No. 5 Morse taper tailstock. Motor enclosed 400/3/50. Isolator and starter. Coolant tank. 14in. 4-jaw chuck, 4-way toolpost.—ROLLS TOOLS, LTD., Pyrford Road, Pyrford, Woking, Surrey.

Cashmores

Selection of Machine Tools from Stock

CENTRE LATHES

New **WILLSON** Mark 1 6½in. Sloping Bed Lathe, A.G.H. S.S. & S.C. Gap Bed to admit 2ft. 6in. between centres.
MITCHELL OF KEIGHLEY 8½in. S.S. & S.C. Lathe to admit 4ft. 3in. between centres.
MITCHELL OF KEIGHLEY 10½in. S.S. & S.C. Lathe to admit 4ft. 0in. between centres.
VOLMAN 8in. S.S. & S.C. Gap Bed Lathe to admit 4ft. 6in. between centres.

BORING MACHINE

WEBSTER & BENNETT 36in. Vertical Boring Mill, table speeds 5.6/125 r.p.m.

DRILLING MACHINES

ARCHDALE 5ft. Elevating Arm Radial Drilling Machine, No. 5 M.T. spindle.
New **RICHMOND** Model SR.2 3ft. 0in. Radial Drilling Machine. Fixed arm No 3 M.T. spindle.
SWIFT 4ft. 6in. Model A1 Elevating Arm Radial Drilling Machine, No. 4 M.T. spindle, motorised 400-440/3/50 cycles.
New **KITCHEN-WALKER** 4ft. 6in. Radial Drilling Machine, No. 5 M.T. spindle.

GRINDING MACHINES

BROWN & SHARPE No. 5 Horizontal Spindle Surface Grinding Machine, 24in. × 8in. capacity, hydraulic feed to table.
JONES & SHIPMAN Vertical Spindle Surface Grinding Machine, 18in. × 6in., hydraulic feed to table.
NORTON 6in. × 30in. Hydraulic Plain Cylindrical Grinding Machine, maximum wheel diameter 20in.

MILLING MACHINES

CINCINNATI No. 4 Horizontal Plain Milling Machine, 78½in. × 16in. table.
HYPERMILL 7/27 Production Type Milling Machine, 43in. × 10in. table.
MIDGLEY & SUTCLIFFE Hand Lever Feed Milling Machine, 16in. × 5in. table.
EDGWICK No. 2 Dial Type Plain Horizontal Milling Machine, 46in. × 11in. table.
ARCHDALE 20in. Dial Type Horizontal Milling Machine, 40in. × 12in. table.
GREENWOOD & BATLEY Plain Horizontal Milling Machine, working surface of table 20in. × 10in.
EDGWICK 18in. Horizontal Plain Production Milling Machine, with 40in. × 12in. table.

POWER HAMMERS

ALLDAYS & ONIONS 2 cwt. Clear Space Type Pneumatic Power Hammer.
MASSEY 5 cwt. Pneumatic Side Type Power Hammer.

SAWING MACHINES

New **WICKSTEED** 10in. capacity Power Hacksaw.
New **STARTRITE-SABRE** Vertical Metal Cutting Bandsaw, 20in. throat.

SLOTTING MACHINES

BUTLER 14in. stroke All Geared Slotting Machine with 39in. diameter rotary table.
DUTRANNOIT 24in. stroke Precision Slotting Machine with swivelling head, 39½in. table.

SHAPING MACHINE

New **INVICTA** 24in. and 18in. stroke Shaping Machines.

SHEARING MACHINE

New **KEETONA** 8ft. 0in. × ¼in. Undercrank Guillotine Shearing Machine.

STRAIGHTENING ROLLS

BRONX 8ft. 0in. × ¼in. Straightening Rolls, 5 roll type.

All the above machines are motorised 400-440/3/50 cycles.

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Classified Advertisements (*PLANT FOR SALE, contd.*)

F. J. Edwards Ltd

MILLING MACHINES

COCHRANE-BLY No. 14 Duplex Universal Vertical Milling and Shaping Machine, table 29in. × 9in., main head swivel 360 deg., shaper ram stroke 0in.-6in.
KENT-OWENS No. 1-14 Production Miller, table 32in. × 9in., hydraulic feed and rapid traverses.
KENT-OWENS No. 1-8 Production Miller, table 25in. × 9in. U.S. Model MM.5 Multi-Production Miller, table 21¼in. × 6in.
HERBERT No. 46V Vertical Milling Machine, table 58in. × 15in., auto longitudinal feed 36in.
NEW Vertical Millers, with swivel head; table 33½in. × 10in., speeds 90 to 1,500 r.p.m.
CINCINNATI 08 High Speed Vertical Miller with power feed and rapid traverse, table 20in. × 6in., speed 150-1,300 r.p.m.
REED PRENTICE No. 2 Vertical Miller, 20in. × 8¼in., table, capacity 16in. × 11in. × 15in.
BROWN & SHARPE No. 2 Vertical Miller, swivel head, table 45in. × 10in., capacity 28in. × 10in. × 15in.
CURD NUBE 2-spindle Vertical Profile Miller, table 17¼in. × 14¼in.
PROGRESS Universal Milling Machine, table 40in. × 10in.; capacity 24in. × 9in. × 18in.
VICTORIA U.1 Universal Miller, table 40in. × 11in.; capacity 25in. × 8in. × 16in., speeds 31 to 1,010.
VICTORIA U.2 Universal Milling Machine, table 45in. × 11in., with vertical milling attachment, slotting attachment and rotary table.
MILWAUKEE 2K Universal Miller, table 56in. × 12in., capacity 28in. × 10in. × 17in., 1,500 r.p.m.
CINCINNATI No. 2 Dial Type Universal Miller, table 49in. × 10in., capacity 28in. × 10in. × 16in.
BROWN & SHARPE 2A Universal Miller, table 45in. × 10in., capacity 28in. × 10in. × 18in.

PLANING MACHINES

BUTLER 36in. Openside Crank Planers; side head.
4ft. × 2ft. × 2ft. Planer.

SAWING MACHINES

TAYLOR No. 1 Cutting Off Machine, for 4in. tubes; 1¼in. bars.
NEW **KALTENBACH** Model HDM 750 Hydraulic Circular Sawing Machines; 30in. dia. blade to cut 9in. dia. bar, 16in. × 6in. R.S.J. SOLE BRITISH AGENTS.
NEW **KALTENBACH** 14in. Blade Model KKS 350 Universal Circular Sawing Machine to cut steel and non-ferrous metals any angle from 0 deg. to 180 deg. Send for particulars of this unusually versatile machine. Demonstrations gladly arranged. SOLE BRITISH AGENTS.
COBRA 2¼in. capacity Circular Sawing Machine, mounted on trolley base.
TAYLOR No. 1142 high speed Circular Saw for ¾in. bars, 1¼in. tubes.

SCREWING MACHINES

KENDALL & GENT Screwing Machine 3in. bolts, 6in. tubes. Tangential Diehead with leadscrew.
KENDALL & GENT 3-2 Screwing Machine, capacity 3in. pipes, 2in. bolts, tangential diehead, lead screw control.
MAIDEN 2in. Screwing Machine, with Lanco tangential diehead.
LANDIS 1¼in. Tangential Diehead Screwing Machine.
OSTER 6in. capacity Screwing Machine with cutting-off attachment for pipes; fully equipped.

SHAPING MACHINES

GOULD & EBERHARDT 20in. Shaper.
BUTLER 12in. and 18in. Shaper.
ALBA 24in., 18in., 14in. and 10in. Shapers.
ORMEROD 26in. stroke Traversing Head Shaping Machine, with two universal box tables. 1955 machine.

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BETTS 12in. stroke heavy duty Slotting Machine.
NEW 7¼in. stroke Toolroom Slotters.

359-361, EUSTON RD., LONDON, N.W.1
Telephone: EUSTON 5000 Telex : 24264
And at Lansdowne House, 41, Water St., Birmingham, 3 *Telephone: Central 7606-8*

AUTOS

CONOMATIC 1¼in. 8-spindle Type W.W.
WICKMAN 2½in. 5 spindle Auto. 1941 machine.

BORERS

UNION Model BFT 100/11. 4in. spindle.

DRILLING

ASQUITH 4ft. O.D.1 Radial Drill.
PROGRESS 5E Round Table.
ARCHDALE 28in. Heavy Duty Pillar Drill.
NEW—**MAS** Model V.R.2, 3ft., Elevating Arm Radial Drill.
MAS Model V.R.4, 4ft. 6in., Elevating Arm Radial Drill.

LATHES

SOUTHBEND 16in.
EDGWICK 7in.
DEAN, SMITH & GRACE. Height of centres 7in.
MONARCH 22M, S.S. Taper Turning Lathe.
WARD 10 Combination Turret Lathe.
WARD 7 Combination Turret Lathe.
LANG 10½in. Gap Bed. 5ft. between.

MILLING

28in. **ARCHDALE,** Rapid all ways.
18in. **EDGWICK** Production Mill.
CINCINNATI No. 5 High Power Plain Hor. 1942 machine.
MILWAUKEE 2 HL Vertical—rebuilt.
MILWAUKEE 2K Plain—overhauled.
MILWAUKEE 3KM Universal, metric, with dividing head.
PEGARD Bed Type Vertical, table 84in. × 29in.—slightly used.
KENDALL & GENT Model C.V.M. 25.
NEW—**GIEWONT** Model F.Y.C. 25 No. 2 Vertical Miller, 44 × 10in. table. Delivery mid-October.

GRINDING

NEW—**RIBON** Model R.V.R.1000, 10 × 40in.

SHEETMETAL

GUILLOTINES
TRIUMPH 6ft. × ⅛in. Overcrank.

All machines motorised 400/3/50

STANCROFT LTD.,

BEDWORTH ROAD, COVENTRY.
Telephone Coventry 88072/3.

Brown & Sharpe Automatics, double chain drive 2G with top slide and slotting head, Ser. 10518, and OG, Ser. 12138. Gears, barfeeds, etc. First class condition.—C. L. THOMAS, LTD., Stirling Road, Solihull. Tel. 3075-6.

Hilmor Motor Driven Tube Bending Machine for sale. Mandrel type. MAX. capacity: copper tubes 2¼in. bore × 10 gauge; steel tube 2in. O.D. × 10 gauge; conduit 2in. O.D.; gas and steam tubes 1¼in. nominal bore. Motor drive 400-440 3/50.—F. J. EDWARDS LTD., 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham 3.

Electric Motors, New and Secondhand, over 4,000 always available for sale, part exchange or hire. Prompt repairing service in event of breakdown.—JOHN RODWELL, LTD., Vicarage Road, Hornchurch. Hornchurch 48877 (3 lines).

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Size 10" long; 3¼" wide; 7" high. Min. lots of 10 at 32/6 plus carr.
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AUTOMATICS

B.S.A. Acme Gridley ⅜in. 6 spindle. Rebuilt machine.
CONOMATIC 1¼in. 4 and 6 spindle. Rebuilt machines.
RYDERMATIC No. 12 Vertical Multi-Tool Lathe.

BORER

KEARNS No. 1 Patent.

BROACH

FORST RIA5 Universal Vertical Broach for internal and surface broaching. 5 tons, 39½in. stroke. 1952 machine.

GRINDERS

PALLAS No. 2 Surface 18in. × 6in.
BROWN & SHARPE No. 2 Surface.
New ALPA Surface, 32 × 8in.
ABRASIVE 3B Surface 24in. × 8in.
JUNG AS Internal.
KEIGHLEY Type XL Hydraulic Plain Grinder, 6in. × 18in.
CHURCHILL 10in. × 24in. Universal.
LANDIS 12 × 48 Universal.
BROWN & SHARPE No. 3 Universal.
NORTON 14in. × 36in. Universal.

CAPSTAN AND TURRET LATHES

MURAD 3Q ⅜in. Capstan.
HERBERT 2S Bar Feed Capstan.
GISHOLT No. 5 Bar Feed Capstan.
LIECHTI PR Turret Lathe (Swiss).
GISHOLT Turret Lathes, Type 1L.
FOSTER No. 2B Turret Lathe.

CENTRE LATHES

HENDEY 6in. × 30in. Taper Turning.
MONDIALE 7in. × 60in. Gap Bed.
CROMWELL 3½in. Precision.

MILLERS

RICHMOND 01 Universal.
HERBERT No. 1 Hand Lever. Rebuilt.
ADCOCK & SHIPLEY Model OA with "Multiform" Auto. feed. Rebuilt.
WERNER No. 5160 Small Multipurpose. Vert. and Horiz. Table 22in. × 6½in.
ARCHDALE 14in. Manufacturing type.
CINCINNATI Type OK 18in. Horiz.
EDGWICK 18in. Horizontal.
ARCHDALE 20in. Twin Overarm Horizontal. Table 40in. × 10in.
BROWN & SHARPE No. 2 Light Type Horizontal.
KENT-OWENS 1-8 and 1-14 Hydraulic Production.
OLIVETTI FP2 Production—Unused.
CINCINNATI 3-24 Plain Hydromatic.
CINCINNATI 4-36 Duplex Hydromatic.
New TAYLOR Vertical, table 17¾in. 5¼in.
HERBERT 23V Vert. Table 68in. × 17in. 48in. traverse.
HELLER Automatic Thread Millers (4).
ASQUITH HKO Duplex Keyseater.

PRESS

V. & O. No. 11 Double Action. Approx. 10 tons. Roll feed. Max. draw 1in.

All machines motorised 400/3/50 unless otherwise stated.

ACBARS LIMITED,

331-3, WALWORTH ROAD, LONDON, S.E.17.
Telephone: RODney 7822.
Telegrams: Acfirb London S.E.17.

Corona Heavy Duty Vertical Drilling Machine. No. 5 Morse Taper. Excellent condition.
Further details from:—
C. & G. OLDFIELD, LTD.,
15, Abercorn Street,
PAISLEY.

Newman

AUTOMATICS

BULLARD Multi-Au-Matic 7in. 8 spindle.
BULLARD Multi-Au-Matic 12in. 6 spindle.

BORING MACHINES

WETZEL Horizontal traversing column Floor Boring and Facing Machine, 7in. diameter travelling spindle, 45in. diameter facing head. (Two available.)
KEARNS Model OB Horizontal Boring and Facing Machine, 2½in. diameter travelling spindle (1957).
UNION Model BFT100 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle (1955).
KEARNS Model OC Horizontal Boring Machine, 3in. dia. travelling spindle.
KEARNS No. 4 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle.
WEBSTER & BENNETT Vertical Boring Machine, table 50in. diameter.
RICHARDS Type PRT Horizontal Floor Boring Machine, 3½in. travelling spindle, 28in. diameter facing head.

CAPSTAN AND CENTRE LATHES

CHURCHILL-REDMAN Model 13NM Heavy-Duty S.S. & S.C. Gap Bed Centre Lathe, 13in. centre height × 72in. between centres. Swing in gap 50in.
MITCHELL Model DM10 S.S. & S.C. Gap Bed Centre Lathe, 10½in. centre height × 7ft. 5in. between centres. (NEW.)
OLDFIELD & SCHOFIELD Surfacing and Boring Lathe, 10½in. centre height.
WARD 7B Combination Turret Lathe.
NILES Heavy Duty Centre Lathe, S.S. & S.C. 17in. centre height × 28ft. between centres.
U.L.R.O. Heavy Duty Centre Lathe, 16in. centre height × 30ft. between centres.

DRILLING MACHINES

HETTNER Radial Drilling Machine, 10ft. elevating arm.

GEAR MACHINES

ORCUTT Model HM24 Hydraulic Internal Gear Grinder.
GLEASON 3in. Straight Bevel Gear Generator.

GRINDING MACHINES

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CHURCHILL Plain Cylindrical Grinding Machine, 26in. swing × 84in. between centres (1951).
LANDIS Type C Plain Hydraulic Cylindrical Grinding Machine, 6in. swing × 18in. between centres.
ORCUTT Model HM24 Internal Spur Gear Grinding Machines.
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BROWN & SHARPE Plain Cylindrical Grinding Machine, 10in. swing × 36in. between centres.

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CINCINNATI No. 2L Plain Horizontal Milling Machine, table 52in. × 10in.
CINCINNATI No. 1M Vertical Milling Machine.
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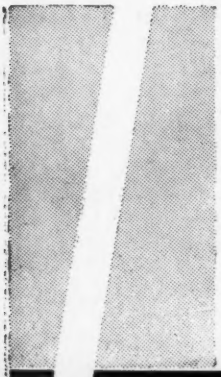

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MANURHIN Type PDI2A Automatic with Hopper feeds for parting off and chamfering Cartridge Case heads. 5 machines. (These nearly new machines may be adapted for other work and are offered at the lowest price.)
RYDERMATIC No. 18 Vertical Automatics 60 H.P.

BORING MACHINES

MATHEYS Model FPN/28 Semi Jig Borer. (1956.)
PADDON Mk. 3 type WP Cylinder Re-Boring Machines.

HONING AND LAPPING

WOLTERS Model I.L.I. Hydraulic Internal Lapping Machine.
DELAPENA Honing Machine.

CAPSTANS AND TURRET LATHES

BOLEY-LEINEN Model ER 15 ¾in. Capstan (Modern) (1953).
HERBERT No. 2 Pre-optive Bar Turret Lathe. Flamard bed, 2in. capacity with bar feed, full turret tooling.
HERBERT Model 22A Turret Lathe. 8¼in. Spindle Hole.
LIBBY 2H 8in. spindle Turret Lathe.
MURAD ¾in. capacity with full equipment.

CENTRE LATHES

Two **WILLSON** 7¼in. Newel Lathes.
SOUTHBEND 7in. Centre Lathe.
CRAVEN Heavy Duty Railway Wheel Lathe, swing 6ft. by 12ft., vee belt drive. Weight 25 tons.
New **CAPITOL** 9¾in. Centre Lathe admitting 6ft. between centres.
FACEPLATE Lathe, 9ft. swing.
DEAN, SMITH & GRACE 9in. by 5ft. 6in. Centre Lathe.

GRINDING MACHINES

OLIVETTI Model R 4-500 plain cylindrical grinder (1953).
MOPCO Model RUP 108YW. Combination horizontal and vertical spindle toolroom hydraulic Surface Grinder, table 38in. by 11in. (1953).
ZENITH Model PH Horizontal Spindle Hydraulic, Surface Grinder, 24in. by 8in. (1953).
VICO (Swiss) Hydraulic Toolroom Universal Grinder 10in. by 30in. (1953).
CRAVEN Heavy Duty Roll Grinding machine with capacity for rolls 42in. dia. by 12ft. between centres and fitted with automatic cambering. Will take rolls up to 25 tons weight. Fully motorised machine of modern design. Weight 25 tons.
WALDRICH SIEGEN Roll Grinder. 36in. by 13ft. between centres.
LOTH Universal Grinder (new).
Two **CINCINNATI** No. 2 Tool and Cutter Grinding Machines.
COVEL No. 2 Tool and Cutter Grinding Machine.
IMPERIA Tool and Cutter Grinder, Model M6 AR. (1953).
MATRIX No. 16G Plain Straight Thread Grinder.
SCRIVENER No. 1 Centreless Grinder.
BLAKE No. 1 Tap Chamfering Machine (New).
MATRIX No. 6 Internal Thread Grinders 3in. by 10in.
HEALD Model 81 Sizematic Internal Grinder.
PETEWE Model 3D Profile Grinding Machine (Nearly New).

DIESINKING MACHINES

VICTORIA Duplomatic Hydraulic Copy Milling Machine, 8in. by 8in. (New).

DRILLING MACHINES

ASQUITH Model ODI Radial Drilling Machine 4 M.T.
PACERA ½in. Bench Drill (New).
Two **ARCHDALE** 36in. Radial Drilling Machines. No. 4 M.T.

GUILLOTINES

BESCO 42in. by 10 s.w.g. Power Guillotine.
HANDS 4ft. by ¼in. Guillotine.
RHODES 6ft. by ¼in. Guillotine.

MILLING MACHINES

MILWAUKEE Model 5H Vertical Mill, dial type, high speed model with power down feed to head, table 94in. by 18in. (New price U.S. $36,680. This machine is in beautiful condition, offered at a fraction of replacement cost.)
FRITZWERNER Model 8101 Automatic Miller (1953).
EDGWICK No. 1 Horizontal Milling Machine 40in. by 10in. table.
DENBIGH Model No. C4 Horizontal Milling Machine.
SANT ANDREA Model U.F.O/5 Heavy Duty Horizontal Miller. 86¼in. by 19in. Table travel 67in. (1953).

. . . *a few yards from Olympia and Earls Court*

348-354 KENSINGTON HIGH STREET - LONDON - W. 14
WEStern 7031 (5 lines)

VICTORIA Junior Omnimil (New).
Two **ARCHDALE** 18in. Automatic Cycle Kneeless Production Millers.
SOMUA Model FH2C Horizontal Miller table 67in. by 14¼in. (1953).
CUNLIFFE & CROOM No. 2 Vertical Mill (dial).
FACKS Thread Miller.
ARCHDALE 34in. Plain Horizontal Miller (nearly new).
BEAVER Model VRBP Vertical Miller (New).

PLANING MACHINES

STIRK 16ft. by 5ft. double column Planers, four toolboxes; modern machines with Lancashire drive (Two).
HOLROYD Plano Mill 17ft. 6in. by 9ft. 6in.

POWER PRESSES

RHODES 1-Ton Open Fronted Bench Press with flange motor and UDAL guards.
LEE & CRABTREE 15-ton Horning Press.
LEE & CRABTREE 20-Ton Horning Press.
LEE & CRABTREE 35-Ton Double Action Mechanical Press.
RHODES 150-Ton Double Sided, Geared, Adjustable Stroke Power Press (1956).
H.M.E. Model DCP3 70-ton Double Sided, Double Crank, Single Action Power Press.
Three New **MULLER** Model AMP 22-ton Power Presses.
Three New **MULLER** Model AMP 35-ton Power Presses.
Two New **MULLER** AMP 45-ton Power Presses.
Two New **MULLER** AMP 60-ton Power Presses. Open Fronted.
Two New **MULLER** AMP 80-ton Power Presses.

SHAPING MACHINES

BERRY 16in. Shaper.
BROOK 18in. Shaping Machine.
KLOPP 22in. Shaping Machine.
TORPEX 22in. Shaping Machine.
New **LIMA** 22in. Shaper.

SAWING AND FILING MACHINES

WESPA AS4 Bandsawing and Bandfiling Machine, hydraulic feed (similar Do-all V/16).

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MIKRON No. 79 Gear Hobber (almost new).
SAFAG Model 24 Cutter Relieving Machines.
LAMBERT Model 66 Gear Hobber.

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CAPSTANS
MITTLER type RGII 82.
MURAD 3in.
HERBERT 4B and 4.
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TAYLOR 10in.
DRILLS
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CORONA Type 15CX 2 spindle.
HERBERT 2 spindle.
MONMOUTH 4 spindle No. 2 M.T.
ARCHDALE 3ft. Radial No. 3 M.T.
DENBIGH 24in. B.G.
HERBERT "C" Power Feed.
CORONA No. 2I AR, No. 3 M.T.
JONES & SHIPMAN 816, ½in. cap.
CORONA 1AX, No. 1 Morse Taper.
LELAND GIFFORD 2-sp., No. 2 M.T.
HERBERT Type B. Single Spindle, ½in.
CORONA 6MX Cluster Type.
HERBERT Type H, ½in. cap.
ENGRAVERS
T.T. & H. 3 dimensional.
ALEXANDER No. 2, 3-dimensional.
LIENHARD 3-dimensional. (New.)
LIENHARD No. 1H.
HUPFIELD Router.
T.T. & H. Type C, C.B. and M.A.
T.T. & H. Multi Etcher.
FILING AND SAWING MACHINES
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WICKSTEAD No. 1 Hacksaw.
RAPIDOR 6in. Hacksaw.
RAPIDOR Filing.
FOLDERS
Sheet Edging, 30in. × 22g.
GEAR CUTTERS
SAFAG Pinion.
MAXICUT 7in. × 2in. × 6 D.P.
PETERMAN No. 1 and 2.
GRINDERS (Internal)
CHURCHILL HBY.
BRYANT 16/39 and 5.

GRINDERS (Surface)
CHURCHILL OSB 8in. × 30in.
LUMSDEN Vert. 210 XXM.
ABRASIVE No. 34 Vertical Spindle.
GRINDERS (Cylindrical)
CHURCHILL 6 × 36in. B.Y.
CHURCHILL PBH 12 × 36in. Univ.
NEWALL 6 × 18. Model XL.
GRINDERS (Miscellaneous)
BROWN & SHARPE No. 10 and 13 T. & C.
J. & S. "Perfect Point" 0·010in.-¾in. Drill.
JONES & SHIPMAN, 10in. × 27in. T. & C.
J. & S. Drill, ¼in. to ¾in.
STEDALL WUNDERLI Carbide.
ROWLAND 12in. × 2in. Single Wheel.
WICKMAN NIVEN Carbide.
WADKIN Saw Sharpener.
JACKMAN D/E 18in. Disc.
EXCEL Model OS. T. & C.
TURNER 14/20 20in. × 3½in. wheels C/E.
NEWALL 420 Univ. Threads.
HUNT No. 0 and 1 Tap Regrinders.
HUNT No. 0, 2 and 3 Drill.
CHURCHILL Valve.
HONER
DELAPENA 4-speed.
KEYSEATERS
BENTLEY 5in.
ASQUITH H.K.O. Horiz. Duplex.
EDGWICK 4in.
LATHES
DEAN, SMITH & GRACE 7in. S.S. & S.C.
CHURCHILL Cub, 6in. × 24in. S.S. & S.C.
SOUTHBEND 13in. S.S. & S.C.
DENHAM 4½in. × 24in. S.S. & S.C.
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RIVETT S.S. & S.C. 4in. Model 602.
SOUTHBEND 10in. Toolroom.
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MONARCH 10EE × 22in. S.S. & S.C.
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RIVETT 3½in. Plain. Model 715.
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MISCELLANEOUS MACHINES
LUKE & SPENCER 38in. × 4 HP Polisher.
CANNING 54in. × 2 HP Polisher.
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DENBIGH C4. Table 46 × 10.
CINCINNATI O8 Production.
CINCINNATI 1/18 Production.
ROSCHER EICHLER. Table 39in. × 12in.
ST. ANDREA Model UFO3 Table 57 × 14.
KENT OWEN 1/8 Production.
HARDINGE Precision. Table 25 × 6½.
WERNER. Table 14 × 5.
JONES 225 Univ. Table 22 × 6.
ARCHDALE 20in. dial and 14in. mfg.
RICHMOND O3. Table 40 × 10.
U.S. Multi Mill.... Production.
MILLERS (Vertical)
REED PRENTICE No. 2.
BROWN & SHARPE No. 2 Light.
C.V.A. 79 Tool and Die.
REED PRENTICE No. 5, 68in. × 16in. table.
WADKIN Type LXIA. Table 36in. × 13in.
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BLISS No. 18. Adj. Str.
BLISS No. 16 Bar.
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WRIGHT Clicking Press.
PROFILING MACHINE
CURDNUBE 2 Spindle. Model KIV.
RIVETERS
HIGH SPEED Hammer, 7/16 cap.
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NEWEY 14in.
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BESCO 21in. × 14in. Rolls.
BESCO 48in. Power Guillotine.
SLOTTERS
EDGWICK.
TAPPERS
ESSEX No. 24, ½in. cap.
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THREAD MILLERS
WICKMAN MOULTON 1B.

Kitchen & Wade H5 Horizontal Boring and Drilling Machine, complete with Square Box Table and Auxiliary Revolving Table. Machine equal to new.

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EARLY DELIVERY
MITCHELL OF KEIGHLEY 8½in. Type DMS Gap Bed Lathe, by 5ft. 3in. B.C. 400/440/3/50. Instant delivery.
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Rhodes Inclinable 40-ton Press, geared, 2in. stroke, tiebars, 400/3/50, also Taylor & Challen 40-ton Inclined Double Roll Feed Press with scrap cutter, 1½in. stroke, 4½in. wide rolls.—C. L. THOMAS, LTD., Stirling Road, Solihull. Tel.: 3075/6.

Wild Barfield Electric Laboratory Oven for sale. Type L03B, for 240 volts, 1 phase, 50 cycles, 4 kW for 50 deg. to 300 deg. C. Inside size left to right × front to back × height 17½in. × 19in. × 20in. Thermostat control and thermometer.—F. J. EDWARDS LIMITED, 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham 3.

Nassovia. Practically New Model V11 Die Sinking Machine, Serial No. 158/1952. First class condition. Price: £2,000 0s. 0d.

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Two 5ft. 9in. Asquith Type PD3 Portable Universal Radial Drilling and Tapping Machines, each on four-wheel bogie, 3 h.p. 400-440/3/50 motor, No. 4 M.T., 18in. feed, 6 speeds, 41-300 r.p.m. Post-war machines. —LEE & HUNT, LTD., Crocus Street, Nottingham. 'Phone 84246.

Herbert No. 4BS Capstan Lathe, fully rebuilt and guaranteed. Chuck model.

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Goss & deLeeuw 6 × 6¾ Tool Rotating 4-Spindle Automatic Chucking Machine. 400/3/50. Threading attachment.—HICKS MACHINERY, LTD., 26, Addison Place, London, W.11. Tel.: PARk 2333.

Cincinnati No. 2 M.H. Plain Horizontal Milling Machine, W.S.O.T., 7in. × 44in.

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Classified Advertisements (*PLANT FOR SALE, contd.*)

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TOWN 26in. stroke Crank Type *SHAPING MACHINE*. 9 speeds 7 to 60 cycles per min. Power down feed. Table size 25½in. × 18in. × 20in. Motor drive 400/3/50. Price: £850

WARD No. 2A *CAPSTAN LATHE*. Power feed to saddle and turret. Spindle speeds 48 to 1,020 r.p.m. With dead length ball chuck and bar feed mechanism. Taper turning to saddle. Motor drive 400/3/50. Price £700

HERBERT Type V 2-spindle Pedestal *DRILLING MACHINE*. With one spindle No. 1 Morse Taper, speeds 440 to 2,945 r.p.m. and one spindle No. 2 Morse Taper, speeds 90 to 2,945 r.p.m. Sensitive feed, with tapping reverse attachment. Motor drive 400/3/50. Price: £285

DEAN, SMITH & GRACE 12in. All Geared Head S.S. & S.C. Gap Bed *CENTRE LATHE*. Admits 4ft. between centres. 3½in. dia. hollow spindle. Swing in gap 42½in. dia. 16 spindle speeds 3.19 to 343 r.p.m. Motor drive 400/3/50. Price: £925

JONES & SHIPMAN Model 1001 Type EN Plain Cylindrical *GRINDING MACHINE*. 12in. swing × 27in. between centres. Hydraulic table traverse. Separate motor drive to workhead giving speeds 40 to 320 r.p.m. Motor drive 400-440/3/50. Price: £1,275

MAIDEN Model ST 6in. capacity *SCREWING MACHINE* with radial diehead. Spindle bored 6½in. Motorised 365/3/50. With large quantity of B.S.P. Taper and Parallel Dies. Price: £525

WEBSTER & BENNETT Type DH 36in. capacity *VERTICAL BORING AND TURNING MILL*. Table speeds by hydraulic control 5.6 to 125 r.p.m. Fitted with pentagonal tool turret. Motor drive 400/3/50. Price: £2,175

STANLEY 7in. All Geared Head S.S. & S.C. Gap Bed *CENTRE LATHE*. Admits 2ft. 10in. between centres. 2in. dia. hollow spindle. Swing in gap 26in. dia. 16 spindle speeds 23 to 824 r.p.m. With Norton type gearbox. Motor drive 440/3/50. Price: £525

JONES & SHIPMAN Model 540 Hydraulic Surface *GRINDING MACHINE*. Table size 18in. × 6in. Hand and auto traverse to table. Hand feed to rise and fall wheelhead. Max. wheel size 7in. × ¾in. With magnetic chuck. Motor drive 400/3/50. Price: £585

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LANDIS 12in. by 48in. Hydraulic Universal Grinder with internal Spindle. **£975.**

COVENTRY Matrix 21 Thread Grinder. **£650.**

CHURCHILL 20in. by 84 Plain Grinder with throw blocks for crankshaft grinding. **£2,850.**

TRIDENT 18in. by 6in. Surface Grinder with P.M. Chuck. **£235.**

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CAPSTANS—LATHES—AUTOS

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150 ton 10ft. by $\frac{1}{16}$in. Press Brake with Fraser Mono Radial. 30 H.P. pumping unit. **£2,750.**

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Two **STEINEL** Model SH4D Horizontal Milling Machines. 30in. by 8in. Table. **£500 ea.**

ADCOCK & SHIPLEY No. 3 Horizontal Miller, with vertical attachment. 50in. by 12in. Table speeds to 1,400. **£395.**

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PROGRESS 4E Pillar Drill. **£150.**

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GLEASON 3IN. SPIRAL GEAR GENERATING MACHINE
Series 16900. Motorised 400/3/50. With many Gear Segment Cams.—ROLLS TOOLS, LTD., Pyrford Road, Pyrford, Woking, Surrey. (Byfleet 43252.)

Krauseco Four Spindle, Upstroking, fine Borer, 400/3/50. Adjustable centres.—HICKS MACHINERY LTD., 26, Addison Place, London, W.11. Tel.: PARk 2333.

Warner & Swasey No. 1A Combination Turret Lathe, Serial No. 484730.
Further details from —
C & G. OLDFIELD, LTD.,
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Member of B.A.M.T.M.

Concord Power Thread Rolling Machine for sale. Capacity, drum lids or similar from 8½in. to 10½in. diameter. Output per minute approx. 20.—Photo, etc., from F. J. EDWARDS LIMITED, 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham 3.

10in. × 36in. Churchill Model BY Hydraulic Plain Grinder. Variable hydraulic feed to table up to 240in. per min. Four workhead speeds 57-200 r.p.m. Hydrauto bearings, 7½ h.p. wheel motor, 20in. dia. wheel. Good equipment. Excellent condition.—LEE & HUNT, LTD., Crocus Street, Nottingham. 'Phone 84246.

Sharples Super-Centrifuge Oil Purifier. Type M/4/P/IE. Motorised.—WILCOX & CO., Barr Street, Birmingham 19. NORthern 1234/5.

Classified Advertisements (*PLANT FOR SALE, contd.*)

Harry Kirk Eng. Ltd.

can recommend the following modern quality machines from STOCK

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WICKMAN 5in. Chucking Automatic.
RYDER Verticalauto, capacity 16in. swing × 8in., 6 spindles.

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KEARNS O.B. Horizontal Boring Machine. 2½in. Spindle. Spindle Speeds 15/600 r.p.m. Excellent condition.
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JONES 6in. Spindle Horizontal Borer. Table 17ft. 6in. × 8ft. Spindle travel 48in. Rapid traverse 84in. per min. Motorised 400/3/50. Weight 70 tons.
BULLARD 36in. Vertical Boring Mill.
KITCHEN & WADE Vertical Fine Boring Machine, 14in stroke. Compound table.

DRILLING MACHINE

ARCHDALE 8-Spindle Hydraulic Vertical Drilling Machine.

GRINDING MACHINES

BROWN & SHARPE No. 2 Surface Grinder 18in. × 6in. table.
KELLER No. R6 Tool and Cutter Grinder.
HEALD No. 172 Gap Bed Internal Grinding Machine, maximum diameter of component 36in.

LATHES

N.D. 8in. × 6ft. S.S. & S.C. Lathe. 30in. between centres.
SMALLPIECE Lathe, type 6 WSLMS.
NOBLE & LUND Heavy Duty Centre Lathe. 22in. centre height × 29ft. between centres Max. swing over saddle 33in. dia.
HARVEY Heavy Duty Centre Lathe. 42½in. centre height × 52ft. between centres Max. swing over saddle 5in. dia.

MILLING MACHINES

EDGWICK No. 2 Universal milling Machine. Working surface of table 38in. × 7½in.
BROWN & SHARPE No. 3A Universal Milling Machine with Vertical Head Attachment. Spindle Speeds 30/1,200. Power feed all movements.
COLLET & ENGLEHARDT Keller Type, Die Sinking Machine Model FKf80, capacity 60in. × 30in

PLANING MACHINES

CLEVELAND Openside Planing Machine, capacity 10ft. × 2ft. 6in.
CINCINNATI Planing Machine, capacity 8ft. × 2ft. 6in

MISCELLANEOUS MACHINES

Hydraulic Vertical Internal Honing Machine (manufactured by **PETER WOLTERS**), Capacity 0.2in. to 2in.
RAPIDAN Double Helical Gear Generating Machine, 12in. diameter capacity

Further details from

HARRY KIRK ENGINEERING LTD.,
BRANDON ROAD WORKS, BRANDON ROAD, COVENTRY

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WALSGRAVE-ON-SOWE 2253 (6 lines).

CHURCHILL REDMAN 32in. Heavy Duty Shaper. 8 ram speeds 8-104 SPM. 11 Auto feeds. Table top area 32½in. × 16in. 400/3/50.
SMITH & MILLS 26in. Heavy Duty Shaper. 8 ram speeds 8-100 SPM. 15 Auto feeds, rapid traverse, swivel base vice, 400/3/50.
ARCHDALE 28in. All Purpose Horizontal Milling Machine. Table size 38in. × 13in. Power and Rapid Power traverse all ways. Spindle speeds 30 to 462 r.p.m. 400/3/50.
ACME GRIDLEY Type RA86 1in. Capacity 6 Spindle Automatic. Screwing and Drilling Attachments. Excellent condition. 400/3/50.
B.S.A. Type RA Gridley 1¼in. Capacity 6 Spindle Automatic. Universal threading attachment, 5th position parting off slide. Late model, extensive equipment. 400/3/50.
ALEXANDER 2A Universal Die Sinking Machine. Table size 14in. × 8in. Copy table 12½in. × 17½in. Ratio 1½-1 to 10-1. 10 spindle speeds 1,900 to 15,000 r.p.m. 400/3/50. Complete with equipment and Universal Cutter Grinder.
H.M.E. Type L 40 Ungeared Open Front Inclinable Power Press. Pressure 40 tons, Adjustable stroke ½in. to 4in. Bed area 29½in. × 21½in. 400/3/50. Operator's Guards.
RUSHWORTH Geared Overcrank Power Guillotine. Capacity 10ft. × ¼in. m.s. 20 Strokes per minute. Motorised 15 h.p. 400/3/50. Complete with automatic hold-down, front and rear gauges, fully guarded and spare set of blades.
RHODES No. 12 Double Sided, Double Crank, Geared, Power Press. Pressure 70 tons. Fitted fixed stroke 4in. Bed area 44in. × 42in. 400/3/50.

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ASTon Cross 2235.

New for Immediate Delivery

CENTEC Model 2B Precision Milling Machine. Power feed to Table.

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FOR QUICK SALE ! BARGAIN PRICES !

For one or lot

Simplex (Milwaukee USA) Vert. mill 45 × 11 3 power feeds rapid return. **Parkson** No. 2 Uni. Mill. Table 51 × 11¼. Dial operation. **Wadkin** 4ft. 6in. Radial. **Pratt & Whitney also Kendal.** Two Spindle profile mills late type as new. LaPointe twin screw h.d. hori. broach Weatherley oil gear vert: broach. *As example of bargains; cost approx.* **£2000, sell £245!**

Two h.d. **Canning** Polishing Buffs, small vert. bench mill on stand. All 400v. 3 ph No. 7 & 3 **Ward** Toolpost's-collets, etc. *SPECIAL:* **National** 17END E1. 12in. book-keeping machine. Many extras. Perfect condition. **Cost £327. Sell £95.**

NEW MACHINES

Troglia 7 × 40 lathe delivery 3-4 weeks.
SURE 10 × 40 Grinder delivery 3-4 weeks.
ZIPP Cutting off Machine ex stock.
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KEARNS No. 2 "Patent" type, with travelling spindle 3in. dia., continuous automatic facing head, facing capacity 30in.; covered bedways, table (main) 48in. × 30in.; maximum distance facing head to outer stay 66in.; 32 speeds from 4.4 to 600 r.p.m.; h p. motor 10.

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STYLES Type Open Fronted Eccentric Press. 60 tons. Variable stroke 3in. max. Table 28in. by 18½in. with 5½in. hole. 9½in. throat. 14in. max. daylight. Fitted with front and side guards. Motor 4 h.p. 400/3/50.

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FINNEY Press, self contained. 5in. dia. ram up stroke. 15in. between columns. 6in. min. daylight. 18in. max. daylight. 12in. adjustable top platen with 3in. dia. screw, operated with 28in. wheel. Hydraulic motor 400/3/50.

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SHAW 4 Column Line Press. 25 tons capacity. Platen 12in. by 12½in. Daylight 15in. Centre ejection.

WERNER PFLEIDERER Hydraulic Down Stroking with Prefil. Capacity 160 tons. Pull back power 31 tons. Ejection power 42 tons. Max. stroke 22in. approx. Stroke ejection 13in. approx. Daylight approx. 35in. Distance between columns 26in. by 37½in. Table area 37½in. by 37½in. 3 throw reciprocating pump No. 73729 with pressure control valve attached. Delivery 8 gallons per min. Low pressure pumps 14.3 g.p.m. Overall size including pumps 13ft. by 8ft. by 3ft. 4in. front to back.

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No. 3 **KEARNS** Horizontal Borer.
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BOX D.226, MACHINERY
Clifton House, Euston Road, N.W.1

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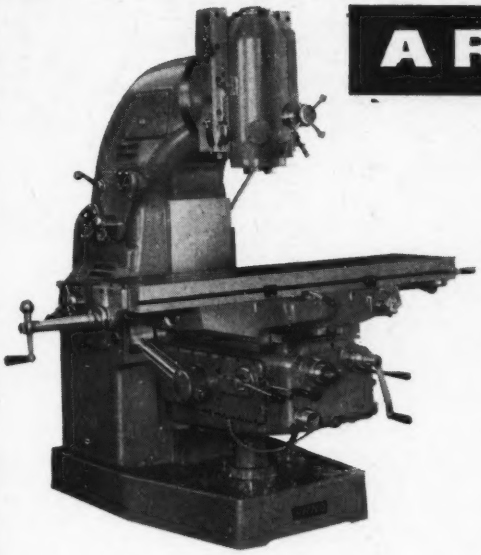

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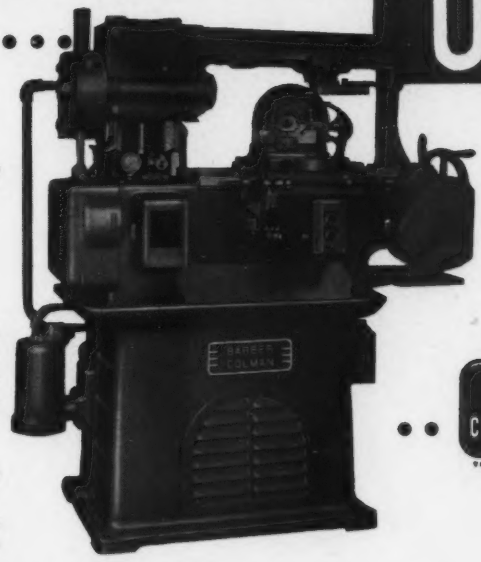

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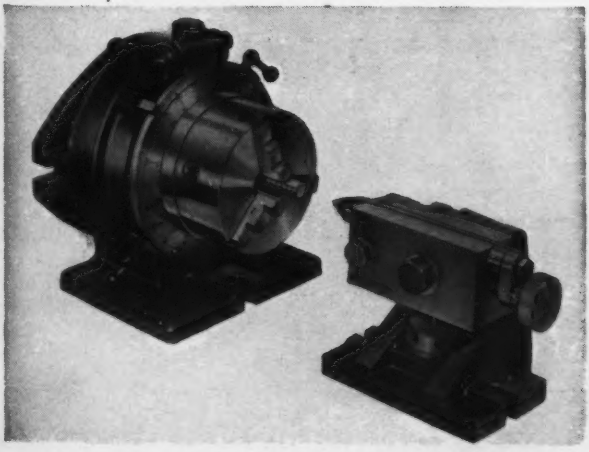

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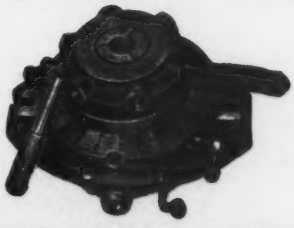

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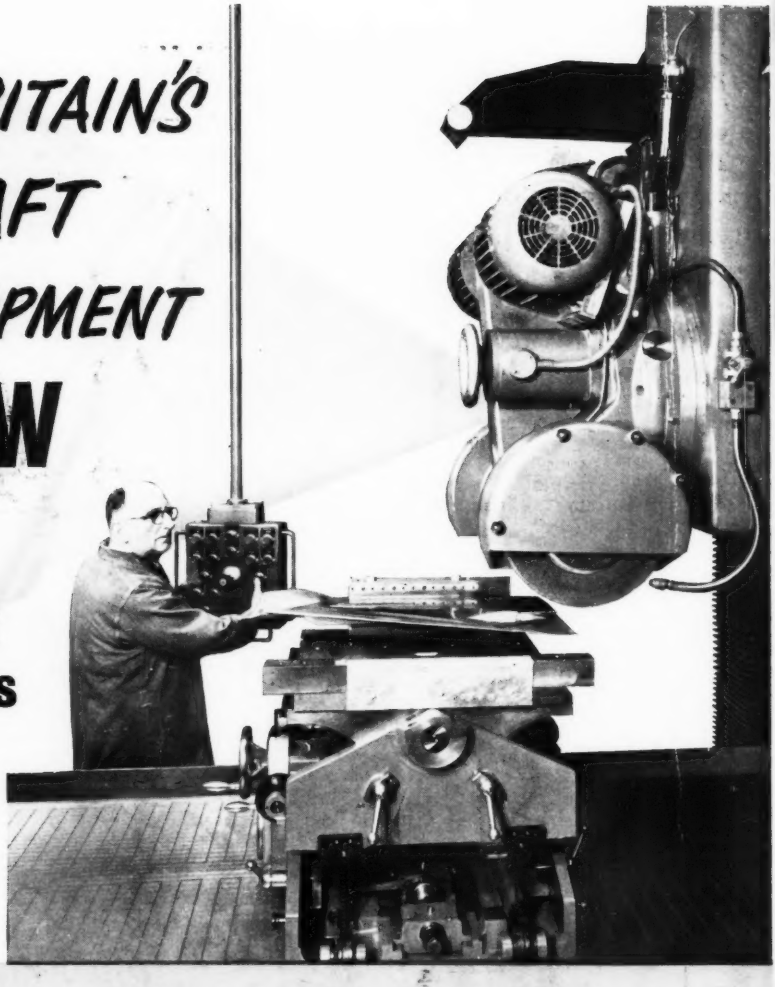

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